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NOTE.—The Register will hereafter form a part of the Circular of Information. In order to bring the dates into correspondence, this issue is designated as 1890-91 B.

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- WILLIAM G. BAKER,  
Examiner for admission in English Studies.

## COURSES OF STUDY AND ADMISSION.

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### GENERAL STATEMENT.

The system of instruction includes :

#### IN THE SCHOOL OF MINES :

##### I.—*Undergraduate Courses.*

1. Mining Engineering.
2. Civil Engineering.
3. Metallurgy.
4. Geology and Palæontology.
5. Analytical and Applied Chemistry.
6. Architecture.

##### II.—*Post-Graduate Courses.*

1. Electrical Engineering.
2. Sanitary Engineering.
3. Special.

#### UNDER THE UNIVERSITY FACULTY OF MINES :

##### *Elective Courses.*

1. For the Degree of Master of Arts.
2. For the Degree of Doctor of Philosophy.
3. Special Courses.

SENIORS OF THE SCHOOL OF ARTS are permitted certain electives.

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### UNDER THE FACULTY OF THE SCHOOL OF MINES.

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#### I.—REGULAR UNDERGRADUATE COURSES.

At the beginning of the first year, each student must elect which of the six courses he intends to pursue, and must thenceforth abide by his election unless permitted by the faculty to make a change.



No student is allowed to pursue more than one course at a time.

The plan of instruction includes lectures and recitations in the several departments of study; practice in the physical, chemical, mineralogical, blowpipe, and metallurgical laboratories; field and underground surveying; practice and study in mines, mills, machine shops, and foundries; projects, estimates, and drawings for the working of mines and for the construction of metallurgical, chemical, and other works; reports on mines industrial establishments, and field geology.

The method of instruction is such that every pupil may acquire a thorough theoretical knowledge of each branch, of which he is required to give evidence, at the close of the session, by written and oral examinations.

#### ADMISSION TO THE REGULAR UNDERGRADUATE COURSES.

Candidates for admission to the first class, at its formation, must be of the age of *eighteen years*, complete; and for admission to advanced standing, there will be required a corresponding increase of age; but this rule may be dispensed with when, in the opinion of the faculty, there are sufficient reasons to justify its relaxation.

Candidates for the first class must pass satisfactory examinations—

In *Arithmetic*, including the metric system of weights and measures.

In *Geometry*, on the nine books of Davies' Legendre.

In *Algebra*, on the first ten chapters of Peck's Manual of Algebra.

In *Physics*, on the equivalent of Ganot's smaller treatise (Peck's Ganot's Natural Philosophy).

In *Chemistry* of the non-metallic elements, on the equivalent to what is contained between pages 131 and 274 in Fownes' Manual of Chemistry, 12th edition.

In *German*, on the general principles of German grammar, including an ability to read in *Das Buch der Natur*, by F. Schoedler, the divisions entitled *Physik* and *Chemie*.

In *French*, on the general principles of French grammar, including an ability to read *Simplex Lectures sur les Sciences*, by M. Garrigues and B. de Monvel, Paris.

In *English Grammar*, on the equivalent of Quackenbos's English Grammar.

In *Composition and Rhetoric*, on the equivalent of Quackenbos's Course of Composition and Rhetoric.

In *History*, on the equivalent of Thompson's History of England and Doyle's History of the United States as contained in Freeman's Historical Course for schools.

In *Physical Geography*, on the equivalent of Appleton's or Guyot's Physical Geography.

In *Free-hand Drawing*, including the ability to sketch, both in outline and with proper shading, ordinary objects, such as a tree, a house, a simple piece of machinery, a piece of flat ornament from a copy, a group of geometrical solids.

In *Book-keeping*, on a knowledge of double entry so far as relates to the keeping of ordinary accounts in cash-book, day-book, and ledger, and the making out of corresponding balance sheets.

An applicant may, at the appointed entrance examinations in May or June, (but not in the autumn,) of one year, be examined in such of the above subjects as are *complete* in themselves, *e. g.*, arithmetic, algebra, or geometry, English grammar, composition and rhetoric, history, and finish his examinations in the requirements for admission at the entrance examinations of the year following.

Examinations for admission will not hold good for more than sixteen months from the date on which they are held.

Diplomas and certificates of other colleges and schools of science will be accepted in lieu of examination, *if satisfactory to the examining officers*. Each examining officer decides the question for his special department.

Candidates for admission to the second or third classes will be permitted to join the summer school in surveying of the class they wish to enter on receiving permission from the officer in charge, and on the payment of the proper fee.

Candidates for advanced standing must pass a satisfactory examination upon the studies named above, and also upon those pursued by the class which they propose to enter. For particulars as to the requirements for advanced standing in each of the courses, see synopsis of studies, p. 24.

Candidates for admission after the opening of a term will be required to pass satisfactory examinations on the part of the course already gone over by the class for which they are applicants.

No candidates are admitted later in the course than the beginning of the fourth year.

The regular examinations for admission are held annually, beginning on the Friday before commencement, and on the

last Monday in September. Candidates will, however, be examined during the session, but not in vacation.

For the convenience of candidates for admission to the first year of the School of Mines who reside at a distance from New York, arrangements have been made by which examinations will be held in June at the following cities:

Chicago, Illinois, by E. G. Barratt, C.E.

Cincinnati, Ohio, by C. B. Going, Ph.B.

Charleston, South Carolina, by P. E. Chazal, A.B., E.M.

Concord, New Hampshire, by C. S. Knox, A.M.

Denver, Colorado, by T. B. Stearns, E.M.

St. Louis, Missouri, by W. B. Potter, A.M., E.M.

Salt Lake City, Utah, by R. H. Terhune, E.M.

Belmont, California, by W. T. Reid, A.M., Head Master of the Belmont School.

## II.—POST-GRADUATE COURSES.

Graduates of the School of Mines, and of other institutions, are admitted to post-graduate courses without examination, provided they have completed the studies which qualify them to pursue with advantage the courses which they desire to attend.

Persons who are not graduates may be admitted to the courses in electrical engineering and sanitary engineering, provided they pass the required examinations.

College diplomas and certificates will be accepted in lieu of examination for the subjects which they cover, if satisfactory to the examining officers.

### I. COURSE IN ELECTRICAL ENGINEERING.

#### FULL COURSE OF TWO YEARS FOR THE DEGREE.

Candidates for admission must pass satisfactory examinations—

In *Mathematics*—Arithmetic, including the metric system of weights and measures; Algebra, the equivalent of Peck's Manual of Algebra; Geometry, Trigonometry, and Mensuration, the equivalent of Davies' Legendre; Geometrical Conic Sections, the equivalent of Peck's Conic Sections; Analytical Geometry, the equivalent of Peck's Analytical Geometry; Differential and Integral Calculus, the equivalent of Peck's Practical Calculus.

In *Physics*, the equivalent of Atkinson's Ganot's Physics.

In *Chemistry*, the equivalent of the inorganic portion of Fownes' Manual of Chemistry.



In *Mechanics*, the equivalent of Peck's Analytical Mechanics.

In *Drawing*, consisting of free-hand sketching, lettering, instrumental and projection drawing.

PARTIAL COURSE OF ONE YEAR FOR CERTIFICATE.

Graduates of colleges and technical schools, and other applicants of adequate attainments and mature age, who are not candidates for a degree, may be admitted to partial courses on giving satisfactory evidence that they are able to pursue with credit and advantage the special topics or studies to which they wish to devote themselves for one year.

2. COURSE IN SANITARY ENGINEERING.

FULL COURSE OF TWO YEARS FOR THE DEGREE.

Candidates for admission must pass satisfactory examinations—

In *Mathematics*—Arithmetic, including the metric system of weights and measures; Algebra, the equivalent of Peck's Manual of Algebra; Geometry, Trigonometry, and Mensuration, the equivalent of Davies' Legendre; Geometrical Conic Sections, the equivalent of Peck's Conic Sections; Analytical Geometry, the equivalent of Peck's Analytical Geometry.

In *Physics*, the equivalent of Atkinson's Ganot's Physics, which includes magnetism.

In *Chemistry*, the equivalent of the inorganic portion of Fownes' Manual of Chemistry. Also the chemistry of air; water; artificial illumination; photography; limes, mortars, and cements; building stones; decay and preservation; timber and its preservation: pigments, paints, essential oils, varnishes; glass and ceramics; explosives: gun-powder, gun-cotton, and nitro-glycerine.

In *Mechanics*, the equivalent of Peck's Analytical Mechanics.

In *Botany*, the equivalent of Bastin's College Botany.

In *Zoölogy*, the equivalent of Nicholson's Manual of Zoology.

In *Geology*, lithological, cosmical, physiographic; historical, including palæontology, (equivalent to Dana's Manual).

In *Microscopy and Biology*, practical acquaintance with the handling of the microscope and microscopical mounting.

In *Hygiene*, the causes of disease, methods of investigation and prevention; vital statistics; first aid to the injured; blood, circulation; muscles; exercise; nervous system; bacteria; contagious diseases; digestion; respiration; ventilation; water supply; disposal of refuse; drainage.

In *Engineering*, general principles relating to materials and structures, physically and mechanically considered. Materials—stone, cements, brick, metals, timber, treated in regard to strength, durability, mode of preparation, defects, tests of quality, and fitness for special uses. Structures—earthwork, execution of earthwork, foundation and supports; superstructure, joints; strength, and stiffness of parts; special rules of construction for masonry of public buildings, retaining walls and arches.

In *Surveying*, use of level, transit, and plane-table, and methods of making topographical surveys.

In *Graphics*, the equivalent of Church's Descriptive Geometry.

In *Drawing*, consisting of free-hand sketching, lettering, instrumental and projection drawing, topographical drawing.

#### PARTIAL COURSE OF ONE YEAR FOR CERTIFICATE.

Graduates of colleges and technical schools, and other applicants of adequate attainments and mature age, who are not candidates for a degree, may be admitted to partial courses on giving satisfactory evidence that they are able to pursue with credit and advantage the special topics or studies to which they wish to devote themselves for one year.

### 3. SPECIAL COURSES.

Graduates of the School of Mines, and of other institutions of like grade and standing may pursue any subjects taught in the school for which they are properly qualified.

Any student of the School of Law, the School of Political Science, the School of Philosophy, or the graduate department of the School of Mines, pursuing a full course, may attend permitted courses in any other school of the college without paying any further fee for tuition.

UNIVERSITY COURSES, UNDER THE DIREC-  
TION OF THE UNIVERSITY FACULTY  
OF MINES.

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DEGREES OF MASTER OF ARTS AND DOCTOR  
OF PHILOSOPHY.

REGULATIONS ESTABLISHED BY ADVICE OF THE UNIVER-  
SITY COUNCIL.

1. Any student who has taken his baccalaureate degree either in Columbia College or in some other college maintaining an equivalent curriculum (every such case of equivalence to be considered on its own merits,) shall be entitled, with the approval of the president, to become a candidate for the degrees of master of arts and doctor of philosophy, or either of them.

2. Each student who declares himself a candidate for the degrees of master of arts and doctor of philosophy, or either of them, shall, immediately upon registration, designate one principal or major subject and two subordinate or minor subjects, which, when approved by the proper faculty, shall be the studies of his university course. Should the subjects designated by the candidate fall within the jurisdiction of more than one university faculty, the candidate's selection must receive the sanction of the president before it is recorded.

3. Candidates for the degrees of master of arts and doctor of philosophy, or either of them, must pursue their studies under the direction of the professors and other officers of instruction in charge of the subjects selected by the candidates as major and minor, attending such lectures as may be designated, and performing faithfully such other work in connection therewith, as may from time to time be prescribed.

4. Students desiring to be examined as candidates for any degree must make written application for such examination to the dean of the proper faculty, on blank forms provided for the purpose.



5. Each candidate for the degree of master of arts, in addition to passing satisfactory examinations on prescribed portions of the subjects selected by him as major and minor, shall present an essay on some topic previously approved by the professor in charge of his major subject. Before the candidate is admitted to examination, the professor in charge of his major subject must have signified his approval of such essay.

6. Each candidate for the degree of doctor of philosophy, in addition to passing satisfactory examinations on the subjects selected by him as major and minor, shall present a dissertation embodying the result of original investigation and research, on some topic previously approved by the faculty. When such dissertation has been approved by the faculty, it shall be printed by the candidate and one hundred and fifty copies shall be delivered to the faculty. On the title-page of every such dissertation shall be printed the words: "Submitted in partial fulfilment of the requirements for the degree of Doctor of Philosophy, in the University Faculty of ——— Columbia College." There shall be appended to each dissertation a statement of the educational institutions that the author has attended, a list of the degrees and honors conferred upon him, as well as the titles of any previous publications.

7. Every candidate for the degree of doctor of philosophy, in addition to passing such other examinations as may be required by the faculty, shall be subjected to an oral examination on his major subject and shall defend his dissertation, in the presence of the entire faculty or of so many of its members as may desire to attend. The ability to read at sight two or all of the following languages—Latin, French, and German—as each faculty may determine, will also be required.

#### SUPPLEMENTAL REGULATIONS OF THE UNIVERSITY FACULTY OF MINES.

1. Candidates for the degrees of master of arts and doctor of philosophy, or either of them, will be admitted to the courses under the control of the Faculty of Mines, subject to the conditions prescribed by the statutes of the college and by this faculty.

2. The course of study shall, so far as possible, embrace instruction in the following groups of subjects:

A.—Mathematics.

B.—Mechanics,  
Physics,  
Chemistry.

C.—Biology,  
Botany,  
Zoölogy,  
Palæontology,  
Mineralogy,  
Lithology,  
Geology,  
Astronomy,  
Meteorology,  
Physical Geography,  
Geodesy,  
Surveying.

D.—Engineering { Civil,  
Mechanical,  
Electrical,  
Sanitary.  
  
Mining,  
Metallurgy,  
Architecture.

3. Referring to section 2 of the regulations prescribed by the University Council—

In the Faculty of Mines the term “subject” shall be held to mean any one of the several subjects of instruction specified under groups A, B, C, and D in section 2. No candidate for a degree may select more than two of his subjects from any one group. The selection of subjects made by any candidate for a degree shall be approved by the dean on behalf of the faculty.

4. Immediately on registration each student shall be given a registration book, on which shall be inscribed the name of the student and the date of his enrolment or registration. In this registration book the student shall enter, at the beginning of each academic year or session, the subjects or titles of the several courses of instruction or investigation which he proposes to follow. At the opening exercise of every such course, or so soon thereafter as may be possible, the student shall present to the professor or instructor in charge his registration book, in order that such professor or instructor may enter therein his name and the date of the opening of the course. At the close of every such course followed by the student, the professor or instructor in

charge shall again enter in the registration book his name and the date of the closing of the course, if the student has faithfully attended the same and performed all the duties required of him in connection therewith. At the time of filing his application to be examined for the degrees of master of arts and doctor of philosophy, or either of them, every candidate must present to the dean his registration book properly signed and dated, as above prescribed, by the professors or instructors in charge of the several courses which he may have attended, as evidence that he is properly entitled to examination for a degree.

5. Referring to section 4 of the regulations prescribed by the University Council—

Applications to be examined for the degree of master of arts or doctor of philosophy must be made on or before April 1st of the academic year in which the examination is desired.

6. Referring to section 6 of the regulations prescribed by the University Council—

In the Faculty of Mines the power to approve the subjects chosen for his dissertation by any candidate for the degree of doctor of philosophy, as well as the power to approve the dissertation itself, shall be delegated to the professor in charge of the candidate's major subject.

7. Referring to section 7 of the regulations prescribed by the University Council—

Every candidate for the degree of doctor of philosophy shall be required to read at sight French and German.

One year's study is required for the degree of master of arts; two years' study for the degree of doctor of philosophy.

#### SPECIAL STUDENTS.

8. Students who are not candidates for a degree shall be permitted to pursue such courses, from among those offered by the Faculty of Mines, as they may be found qualified to enter upon, and the faculty may approve. The qualifications of such students shall be determined by the professor in charge of the courses selected by them.

9. All applications to pursue courses of study, whether as candidates for a degree or otherwise, either wholly or in part under the direction of this faculty, shall be made in writing to the dean, on blank forms prepared for the purpose.

## GENERAL INFORMATION.

## FEES AND EXPENSES.

1. Each student must pay a fee of five dollars (\$5) before matriculation in each year, and such fee must be paid by the applicant for admission before examination; and in case the examination is held at a time not appointed in previous public announcements, the fees required are ten dollars (\$10).

In the case of an applicant who completes his examination for admission at the appointed entrance examinations of two successive years, but one fee of five dollars (\$5) is required.

2. The annual tuition fee is two hundred dollars (\$200), payable one half on the first day of each session.

3. To insure the prompt return in good order of keys to lockers, drawing tables, laboratory tables, and of reagent bottles, a deposit of ten dollars (\$10) will be required.

4. Every student admitted to an extra examination, in anticipation of the time regularly appointed, or in consequence of failure to attend, or to perform satisfactorily at any intermediate or concluding annual examination throughout the course, is required to pay a fee of five dollars (\$5) before being admitted to such examinations.

5. Every candidate for the degree of engineer of mines, or civil engineer, or metallurgical engineer, or bachelor of philosophy, or sanitary engineer, or electrical engineer, is required to pay a fee of twenty-five dollars (\$25) before being admitted to the final examinations.

6. Every candidate for the degree of doctor of philosophy is required to pay a fee of thirty-five dollars (\$35) before entering the examination for such a degree.

7. The necessary expenses of a student are—

|     |                                                                                  |                |
|-----|----------------------------------------------------------------------------------|----------------|
| (a) | Board, including room-rent, fire and light,<br>and washing, per week, from . . . | \$6.50 to \$10 |
| (b) | Matriculation fee . . . . .                                                      | 5              |
| (c) | Annual tuition fees . . . . .                                                    | 200            |
| (d) | Text-books, for the first class, about . . .                                     | 15             |
|     | For the second class, about . . . . .                                            | 30             |
|     | For the third class, about . . . . .                                             | 50             |
|     | For the fourth class, about . . . . .                                            | 20             |
| (e) | Drawing materials for the first and second<br>classes, each . . . . .            | \$15 to 25     |
|     | For each of the others . . . . .                                                 | 5 to 10        |



- (*f*) Laboratory apparatus (for students who take laboratory courses) for each of the four years . . . . . \$30 to 60
- (*g*) During the vacations at the close of the first and second years, travelling and board for summer class in field surveying (for students in the courses of engineering, metallurgy, and geology) . . . . . \$50 to 75
- (*h*) Candidates for admission to advanced standing, who attend the summer school in surveying . . . . . 35
- (*i*) During the vacation at the close of the third year, travelling and board for summer class in practical mining (for students in the courses of mining engineering and metallurgy) . . . . . \$75 to 100
- For the summer class in practical geodesy (for students in the course of civil engineering) . . . . . \$60 to 80
- (*j*) Graduation (final examination) . . . . . 25
8. The fees required of post-graduates attending the school, but not candidates for a degree, are as follows:
- (*a*) Matriculation fee . . . . . \$5
- (*b*) Full fee, entitling the student to all the privileges of the school, per annum . . . . . 150
- (*c*) For the use of the cabinets . . . . . 25
- (*d*) For attendance on lecture-room and other special instruction, per annum for each hour per week of such instruction . . . . . 25
- Or for any number of hours per week as above specified . . . . . 150
- (*e*) For the use of the drawing academy . . . . . 25
- (*f*) For the use of the laboratories or either of them . . . . . 50

Should the amount of fees, exclusive of the matriculation fee, payable by any student, not exceed \$100, the entire amount is payable at the beginning of the academic year, or at the matriculation of the student. Should the amount exceed \$100, payment is required in two equal instalments, one at the beginning of each session of the academic year.

Post-graduates who are candidates for degrees must pay \$150, irrespective of the number of hours of weekly attendance, and for examination,

- For degree of doctor of philosophy . . . . . \$35
- For other degrees . . . . . 25



## FREE TUITION.

It is the desire of the trustees to extend, as widely as possible, the educational advantages of the college to deserving young men. Free tuition is therefore offered to such, under the conditions specified below.

Candidates for free tuition must fulfil the following conditions :

1. The applicant must present a certificate from some person or persons of good repute, stating—

That circumstances are such that he cannot pay the tuition fee ;

That he is of good moral character and studious habits ;

That the writer is not a relative.

Proper blanks will be furnished on application to the registrar.

2. He must exhibit a proficiency in every subject of examination for admission expressed by the number 6 of a scale of which 10 is the maximum. (Conditioned students will not receive free tuition.)

3. He must maintain, subsequent to his admission, a standing in scholarship in every department of study expressed by the number 7, or an average standing in all departments expressed by the number 8, of a similar scale, with no deficiency in any department, failing which he will forfeit his privilege. He will also forfeit his privilege should he be found deficient in any department at the end of the year.

4. Free students are not exempt from the payment of the fees for matriculation, for extra examinations, and for graduation.

## APPARATUS SUPPLIES.

1. Students may purchase apparatus of any of the dealers in the city.

2. To avoid inconvenience and expense to the students, and to secure a proper selection, the school undertakes, at considerable trouble and expense, to lend apparatus on the following conditions :

(a) Each student engaged in laboratory work must make a deposit of forty dollars (\$40) with the registrar, which deposit will be credited to him on the ledger. In case of excessive draughts of apparatus an additional deposit may be required.

(b) Each such student will be entitled, on presenting his receipt at the apparatus room, to draw the regular set of

apparatus for qualitative, quantitative, or organic analysis, for assaying, for microscopy, or for bacteriology, according to his deposit, and from time to time to obtain ordinary articles which he may need, and these will be charged to him. At the end of the session he will be credited with those articles which he returns in good order, and the value of those which he has injured or broken will be deducted from his deposit.

(c) The apparatus room will be open for issuing apparatus every day at convenient hours.

(d) No charge is made for ordinary chemicals.

### EXCURSIONS AND SUMMER SCHOOLS.

During the session, the students may visit the different machine shops and metallurgical establishments of the city and its environs.

During the summer vacations, memoirs, on subjects which will be assigned, are required of students as follows: of students in the courses of analytical and applied chemistry, and of architecture, at the beginning of the second, third, and fourth years; of students in the course of geology and palæontology at the beginning of the fourth year. The time specified for summer memoirs in chemistry is November 1st, of each year, and for other memoirs and summer work the time specified is the second Monday in October.

During the vacation following the close of the second year, students in the courses of engineering may join a volunteer class in practical mechanical engineering under the supervision of the professor of mechanical engineering.

During the latter part of the vacations following the close of the first and second years, students in the courses of mining and civil engineering, metallurgy, and geology, are required to join the summer class in surveying under the direction of the adjunct-professor of civil engineering.

During the vacation following the close of the third year, students in the courses of mining engineering and metallurgy are required to visit mines and engage in actual work or study under the superintendence of the adjunct-professor of mining.

During the vacation following the close of the third year, students in the course of civil engineering are required to attend a summer class in geodesy for six weeks. The class is under the supervision of the professor of geodesy and practical astronomy.

## ACADEMIC YEAR.

The year is divided into two sessions: the first commences on the first Monday in October; the second, on the first or second Thursday of February. The lectures close on the Friday of the fourth week before commencement.

## EXAMINATIONS.

There are two examinations every year, one commencing on the last Monday in January, and the other on the Monday of the third week preceding commencement. The former embraces such subjects only as have been completed during the first session. The latter is the final examination in each department of all the classes for the year.

## COMMENCEMENT AND VACATION.

The annual commencement is held on the second Wednesday in June, on which occasion degrees are publicly conferred.

The summer vacation extends from the day of commencement until the first Monday in October, on which latter day the regular course of study commences.

The exercises of the school are suspended on Ash-Wednesday, on Good-Friday, on public holidays established by law, on such days in each year as may be recommended by the civil authorities to be observed as days of fast or thanksgiving, and for two weeks commencing on the fourth Monday in December, unless the fourth Monday shall fall later than the twenty-sixth day of the month, and in that case commencing on the third Monday.

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NOTE.—To render unnecessary many inquiries addressed to the registrar, it is here stated that there are no dormitories attached to the school.

## BY-LAWS.

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### ENTRANCE CONDITIONS.

1. Students admitted conditionally must satisfy all conditions during the week next following the Christmas vacation, unless the time be extended by vote of the faculty.
2. All entrance conditions must be satisfied within one year.
3. Students who fail to satisfy their entrance conditions within the time specified, will be dropped from the roll.

### ATTENDANCE.

4. Prompt attendance is required upon all the exercises of the school. Each instance of tardiness will be counted as half an absence.
5. Attendance during all the hours specified on the scheme of attendance adopted by the faculty is obligatory.
6. Any student who shall have been absent from more than ten per cent. of the exercises in any subject, shall not be entitled to examination in that subject.
7. If any student be absent from more than one third of the lectures, recitations or exercises in the laboratory or drawing academy in any department, no excuse whatever will be accepted, and he will not be allowed to attend the regular examination in that department.
8. When a student is debarred from attending an examination on account of excessive absences, said debar shall be counted as a failure to pass the examination.
9. Any student who, being present at the school, shall absent himself from any exercise, or shall leave the grounds during the hours at which his attendance is due, shall be liable to removal from the roll of his class.
10. Students are required to attend all the exercises and pass all the examinations of the class and course to which they belong unless specially excused by vote of the faculty.



11. By special permission of the faculty, students may attend exercises not required in the class or course to which they belong, provided that such attendance does not interfere with the required exercises of their class and course. Such students are held to the same rules of attendance and examination in the extra studies as in the required studies of their class and course.

12. Students who obtain on examination a mark of *eight* or more in any subject, may be excused from attendance upon the exercises in that subject. This rule does not apply to students who repeat the studies of any year under by-law 16. Reports of such standing must be filed with the dean of the faculty, who alone is authorized to excuse students from attendance.

13. Any student who shall have passed a satisfactory examination in the School of Arts of Columbia College in any study forming a part of the regular course in the School of Mines, will not be required to pursue that study in the school.

#### EXAMINATIONS.

14. Examinations will be held at the end of the first term (semi-annual), or at the end of the year (annual), on all subjects taught in the school.

15. Any student found guilty of fraudulent practices at examination will be summarily dismissed from the school.

16. Any student who shall fail to pass in any of his studies at the regular semi-annual or annual examination, may present himself for a second examination during the last week of the summer vacation ; failing to pass in this second examination, his name will be dropped from the roll of his class, and he will not be permitted to attend any of the exercises of said class, except by special permission first obtained from the president : but he may enter the succeeding class and pursue all of its exercises and present himself with that class for examination in all studies ; upon failing a third time in any study, his name will be dropped from the roll of the school.

17. Absence from a regular semi-annual or annual examination, unless excused by the faculty, will be counted a failure to pass that examination. This rule shall apply to examinations for delinquents held at the end of the summer vacation.

18. Examinations at times other than here designated are not held except by order of the faculty.

19. Deficient students of the first, second, or third years will not be allowed to attend any summer school without special permission of the faculty.

20. No student is entitled to a degree until he has passed satisfactory examinations in all the studies of the course in which he desires to graduate.

21. When a student fails to receive his degree with his class, and returns at some later period to present himself for examination for the same, he will be required to comply with all the requirements at the later date, and the same rule shall apply to students who have received one degree and make application for another.

22. A student admitted to advanced standing shall be required to show proficiency in those subjects only which have been pursued by the members of the class he wishes to join.

#### STANDING.

23. Every officer keeps a record of the scholarship of each student.

24. The maximum mark is ten in each department, and six is required to pass a student.

25. Free students must maintain a standing of *seven* in every branch of study, or a general average of *eight* in all branches, with no deficiency in any department, failing which they will forfeit their privilege.

#### ANALYSES.

26. Analyses and assays must be made on material supplied or authorized beforehand by the instructor in charge of the laboratory, and the reports must be handed in on the completion of the work.

27. Students pursuing the course of analytical and applied chemistry, and the course of metallurgy, are required to complete the regular list of analyses within the time allotted, and failing in this, they are not permitted to continue with their classes.

#### MEMOIRS AND SUMMER WORK.

28. During the vacations following the close of each year, memoirs on subjects which will be assigned are required of students as follows: of students in the courses of analytical and applied chemistry, and of architecture, at the close of each year; of students in the course of geology and palæontology, at the close of the third year. The time specified for the completion and handing in of memoirs in chemistry

is November 1st in each year; for other memoirs the time specified is the second Monday in October.

29. Students of the second, third, and fourth classes who fail to hand in the memoirs, drawings, and other summer work required of them under the rules by a specified time, shall not be permitted to hand them in until a year from that specified time, and failing in this latter requirement they shall be dropped from the roll of the class.

Under this rule, delinquents in the fourth class cannot graduate with their class at commencement.

#### SUMMER SCHOOLS.

30. Students are not permitted to attend the summer classes in practical mining and in geodesy unless they have previously completed the course of study in the summer school of surveying.

#### PROJECTS AND DISSERTATIONS.

31. Each student, before graduating, is required to execute projects or dissertations on subjects assigned to him by the faculty. These projects or dissertations must be illustrated by drawings made to a scale.

32. All memoirs, projects, dissertations, and drawings executed in the drawing academy may be retained by the school.

#### DEGREES.

33. Every student who has passed satisfactory examinations in all the studies of a course, and completed the required number of projects, dissertations, memoirs, analyses, assays, and drawings, is recommended to the board of trustees for the degree of engineer of mines, civil engineer, metallurgical engineer, electrical engineer, sanitary engineer, or bachelor of philosophy.

#### LIBRARY.

34. The library is open for students from 8.30 A.M. to 10 P.M. daily, throughout the year, including all holidays and vacations except Sundays, Good-Friday, Fourth of July, Thanksgiving Day, and Christmas.

35. Books taken from the library must be returned within two weeks, or earlier if recalled by the librarian as especially needed.

36. Students must give receipts for books taken, and are responsible for their return in good condition.

## THE LABORATORIES AND DRAWING ACADEMIES.

37. No student will be allowed in a laboratory or a drawing academy at a time when his attendance there is not due. During hours assigned for practical work in each of the laboratories and in the drawing academies, the attendance of students will be required. A record of the daily attendance and of the progress of each student will be kept by the officer in charge.

38. The attendance of students of the first and second years in the drawing room at such times as they are not engaged at lectures, between 10 A.M. and 2 P.M., is obligatory for students in engineering and architecture, for such hours and times as may be selected by the professors of engineering and architecture.

## ORDER.

39. Good order and gentlemanly deportment are required of all students, as a condition of attendance upon the exercises of the school.

40. Smoking is prohibited in the college buildings.





# SYNOPSIS OF UNDERGRADUATE COURSES.

## FIRST YEAR.

Subjects required in the courses of—

| MINING<br>ENGINEERING.                                                                                                                                                                                                                                            | CIVIL<br>ENGINEERING.                                                                                                                                                                                           | METALLURGY.                                                                                                                                                                                                                                                       |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>FIRST SESSION.</p> <p>Trigonometry.</p> <p>Physics : Heat, Sound.<br/>Surveying.</p> <p>Botany.<br/>Chemistry.<br/>Qualitative Analysis.<br/>Blowpipe Analysis.</p> <p>Drawing.</p>                                                                            | <p>FIRST SESSION.</p> <p>Trigonometry.</p> <p>Physics : Heat, Sound.<br/>Surveying.</p> <p>Botany.<br/>Chemistry.</p> <p>Drawing.</p>                                                                           | <p>FIRST SESSION.</p> <p>Trigonometry.</p> <p>Physics: Heat, Sound.<br/>Surveying.</p> <p>Botany.<br/>Chemistry.<br/>Qualitative Analysis.<br/>Blowpipe Analysis.</p> <p>Drawing.</p>                                                                             |
| <p>SECOND SESSION.</p> <p>Geometrical Conic Sections.<br/>Algebra.<br/>Analytical Geometry.</p> <p>Graphics.<br/>Physics : Magnetism,<br/>Electricity, Light.</p> <p>Botany.<br/>Chemistry.</p> <p>Qualitative Analysis.<br/>Crystallography.</p> <p>Drawing.</p> | <p>SECOND SESSION.</p> <p>Geometrical Conic Sections.<br/>Algebra.<br/>Analytical Geometry.</p> <p>Graphics.<br/>Physics : Magnetism,<br/>Electricity, Light.</p> <p>Botany.<br/>Chemistry.</p> <p>Drawing.</p> | <p>SECOND SESSION.</p> <p>Geometrical Conic Sections.<br/>Algebra.<br/>Analytical Geometry.</p> <p>Graphics.<br/>Physics : Magnetism,<br/>Electricity, Light.</p> <p>Botany.<br/>Chemistry.</p> <p>Qualitative Analysis.<br/>Crystallography.</p> <p>Drawing.</p> |
| <p>SUMMER VACATION.</p> <p>Surveying.</p>                                                                                                                                                                                                                         | <p>SUMMER VACATION.</p> <p>Surveying.</p>                                                                                                                                                                       | <p>SUMMER VACATION</p> <p>Surveying.</p>                                                                                                                                                                                                                          |

## FIRST YEAR.

Subjects required in the courses of—

| GEOLOGY AND<br>PALÆONTOLOGY                                          | ANALYTICAL<br>AND APPLIED<br>CHEMISTRY.                              | ARCHITECTURE.                                                                                                                                       |
|----------------------------------------------------------------------|----------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|
| FIRST SESSION.                                                       | FIRST SESSION.                                                       | FIRST SESSION.                                                                                                                                      |
| Trigonometry.                                                        | Trigonometry.                                                        | Trigonometry.                                                                                                                                       |
| Physics : Heat, Sound.<br>Surveying.                                 | Physics : Heat, Sound.                                               | Projections.<br>Shades and Shadows.<br>Physics : Heat, Sound.<br>Surveying (optional).<br>Ancient Architectural<br>History.<br>Archæology (French). |
| Botany.<br>Chemistry.<br>Qualitative Analysis.<br>Blowpipe Analysis. | Botany.<br>Chemistry.<br>Qualitative Analysis.<br>Blowpipe Analysis. | Chemistry.                                                                                                                                          |
| Drawing.                                                             | Drawing.                                                             | Design from Dictation.<br>Drawing : Freehand and<br>Architectural.                                                                                  |
| SECOND SESSION.                                                      | SECOND SESSION.                                                      | SECOND SESSION.                                                                                                                                     |
| Geometrical Conic Sec-<br>tions.<br>Algebra.<br>Analytical Geometry. | Geometrical Conic Sec-<br>tions.<br>Algebra.<br>Analytical Geometry. | Geometrical Conic Sec-<br>tions.<br>Algebra.<br>Analytical Geometry.<br>Shades and Shadows.                                                         |
| Graphics.<br>Physics : Magnetism,<br>Electricity, Light.             | Physics : Magnetism,<br>Electricity, Light.                          | Physics : Magnetism,<br>Electricity, Light.<br>Elements of Architecture.<br>Ancient Architectural<br>History.<br>Archæology (French).               |
| Botany.<br>Chemistry.                                                | Botany.<br>Chemistry.<br>Chemical Physics.                           | Chemistry.                                                                                                                                          |
| Qualitative Analysis.<br>Crystallography.                            | Qualitative Analysis.<br>Crystallography.                            | Design from Dictation.<br>Drawing : Freehand and<br>Architectural.                                                                                  |
| Drawing.                                                             | Drawing.                                                             |                                                                                                                                                     |
| SUMMER VACATION.                                                     | SUMMER VACATION.                                                     | SUMMER VACATION.                                                                                                                                    |
| Surveying.                                                           | Memoir.                                                              | Surveying (optional).<br>Memoir.                                                                                                                    |

## SECOND YEAR.

Subjects required in the courses of—

| MINING<br>ENGINEERING.                         | CIVIL<br>ENGINEERING.                                                                   | METALLURGY.                                    |
|------------------------------------------------|-----------------------------------------------------------------------------------------|------------------------------------------------|
| FIRST SESSION.                                 | FIRST SESSION.                                                                          | FIRST SESSION.                                 |
| Analytical Geometry.<br>Calculus.<br>Graphics. | Analytical Geometry.<br>Calculus.<br>Graphics.<br>Engineering.<br>Sanitary Engineering. | Analytical Geometry.<br>Calculus.<br>Graphics. |
| Excavation.                                    | Excavation.                                                                             | Excavation.                                    |
| Zoölogy.<br>Hygiene.<br>Applied Chemistry.     | Zoölogy.<br>Hygiene.<br>Applied Chemistry.                                              | Zoölogy.<br>Hygiene.<br>Applied Chemistry.     |
| Mineralogy.                                    | Mineralogy and Blowpipe<br>Analysis; including<br>Crystallography.                      | Quantitative Analysis.<br>Mineralogy.          |
| Drawing. _____                                 | Drawing. _____                                                                          | Drawing. _____                                 |
| SECOND SESSION.                                | SECOND SESSION.                                                                         | SECOND SESSION.                                |
| Calculus.                                      | Calculus.<br>Engineering.<br>Sanitary Engineering.                                      | Calculus.                                      |
| Tunnelling.                                    | Tunnelling.                                                                             | Tunnelling.                                    |
| Zoölogy.<br>Hygiene.<br>Applied Chemistry.     | Zoölogy.<br>Hygiene.<br>Applied Chemistry.                                              | Zoölogy.<br>Hygiene.<br>Applied Chemistry.     |
| Mineralogy.                                    | Mineralogy.                                                                             | Quantitative Analysis.<br>Mineralogy.          |
| Drawing.                                       | Drawing.                                                                                | Drawing.                                       |
| SUMMER VACATION.                               | SUMMER VACATION.                                                                        | SUMMER VACATION.                               |
| Surveying.                                     | Surveying.                                                                              | Surveying.                                     |



## SECOND YEAR.

Subjects required in the courses of—

| GEOLOGY AND<br>PALÆONTOLOGY                                          | ANALYTICAL<br>AND APPLIED<br>CHEMISTRY.                                                                                    | ARCHITECTURE.                                                                                         |
|----------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------|
| FIRST SESSION.                                                       | FIRST SESSION.                                                                                                             | FIRST SESSION.                                                                                        |
| Graphics.                                                            |                                                                                                                            | Analytical Geometry.<br>Calculus.                                                                     |
|                                                                      |                                                                                                                            | Perspective.<br>Elements of Architecture.<br>Modern Architectural<br>History.<br>Archæology (German). |
| Excavation.<br>Botany.<br>Zoölogy.<br>Hygiene.<br>Applied Chemistry. | Zoölogy.<br>Hygiene.<br>Applied Chemistry.<br>Chemical Philosophy.<br>Quantitative Analysis.<br>Mineralogy.                | Hygiene.<br>Applied Chemistry.                                                                        |
| Mineralogy.                                                          |                                                                                                                            |                                                                                                       |
| Microscopy.                                                          | Microscopy.                                                                                                                |                                                                                                       |
| Drawing.                                                             |                                                                                                                            | Design, Planning, Orna-<br>ment.<br>Drawing: Freehand.                                                |
| SECOND SESSION.                                                      | SECOND SESSION.                                                                                                            | SECOND SESSION.                                                                                       |
|                                                                      |                                                                                                                            | Calculus.                                                                                             |
| Tunnelling.                                                          |                                                                                                                            | Elements of Architecture.<br>Modern Architectural<br>History.<br>Archæology (German).                 |
| Botany.<br>Zoölogy.<br>Hygiene.<br>Applied Chemistry.                | Zoölogy.<br>Hygiene.<br>Applied Chemistry.<br>Chemical Philosophy.<br>Quantitative Analysis.<br>Mineralogy.<br>Microscopy. | Hygiene.<br>Applied Chemistry.                                                                        |
| Mineralogy.<br>Microscopy.                                           |                                                                                                                            |                                                                                                       |
| Drawing.                                                             |                                                                                                                            | Modelling.<br>Drawing: Historical De-<br>sign.                                                        |
| SUMMER VACATION.                                                     | SUMMER VACATION.                                                                                                           | SUMMER VACATION.                                                                                      |
| Surveying.                                                           | Memoir.                                                                                                                    | Surveying (optional).<br>Memoir.                                                                      |

THIRD YEAR.  
Subjects required in the courses of—

| MINING<br>ENGINEERING.                                                                                   | CIVIL<br>ENGINEERING.                                                                                                              | METALLURGY.                                                                                              |
|----------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------|
| FIRST SESSION.                                                                                           | FIRST SESSION.                                                                                                                     | FIRST SESSION.                                                                                           |
| Analytical Mechanics.<br>Physics : Electricity.<br>Engineering.<br>Properties of Materials.              | Analytical Mechanics.<br>Physics : Electricity.<br>Astronomy and Geodesy.<br>Engineering.<br>Properties of Materials.              | Analytical Mechanics.<br>Physics : Electricity.<br>Engineering.<br>Properties of Materials.              |
| Mining.<br>Geology.                                                                                      | Geology.                                                                                                                           | Mining.<br>Geology.                                                                                      |
| Assaying.<br>Metallurgy : Iron, etc.                                                                     | Metallurgy : Iron, etc.                                                                                                            | Quantitative Analysis.<br>Metallurgy : Iron, etc.                                                        |
| Drawing.                                                                                                 | Drawing.                                                                                                                           | Drawing.                                                                                                 |
| SECOND SESSION.                                                                                          | SECOND SESSION.                                                                                                                    | SECOND SESSION.                                                                                          |
| Analytical Mechanics.<br>Physics : Laboratory Prac-<br>tice.<br>Engineering.<br>Properties of Materials. | Analytical Mechanics.<br>Physics : Laboratory Prac-<br>tice.<br>Astronomy and Geodesy.<br>Engineering.<br>Properties of Materials. | Analytical Mechanics.<br>Physics : Laboratory Prac-<br>tice.<br>Engineering.<br>Properties of Materials. |
| Mining.<br>Geology.                                                                                      | Geology.                                                                                                                           | Mining.<br>Geology.                                                                                      |
| Metallurgy : Iron, etc.<br>Drawing.                                                                      | Metallurgy : Iron, etc.<br>Drawing.                                                                                                | Assaying.<br>Metallurgy : Iron, etc.<br>Drawing.                                                         |
| SUMMER VACATION.<br>Practical Mining.                                                                    | SUMMER VACATION.<br>Practical Geodesy.                                                                                             | SUMMER VACATION.<br>Practical Mining.                                                                    |

### THIRD YEAR.

Subjects required in the courses of—

| GEOLOGY AND<br>PALÆONTOLOGY                                               | ANALYTICAL<br>AND APPLIED<br>CHEMISTRY.                                | ARCHITECTURE.                                                                                                                                                 |
|---------------------------------------------------------------------------|------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|
| FIRST SESSION.                                                            | FIRST SESSION.                                                         | FIRST SESSION.                                                                                                                                                |
| Physics : Electricity.                                                    | Physics : Electricity.                                                 | Analytical Mechanics.                                                                                                                                         |
| Mining.<br>Geology.<br>Palæontology.<br>Botany.<br>Zoölogy.<br>Lithology. | Geology.                                                               | Engineering.<br>Sanitary Engineering.<br><br>Mediæval Architectural<br>History.<br>History of Ornament.<br>Theory of Design.<br>Practice (Specifications).    |
| Assaying.<br>Metallurgy : Iron, etc.<br>Biology.                          | Applied Chemistry.<br>Quantitative Analysis.                           | Geology.                                                                                                                                                      |
| Drawing.                                                                  | Metallurgy : Iron, etc.<br>Biology.                                    | Design, Problems.<br>Drawing : Freehand and<br>Historical ;                                                                                                   |
| SECOND SESSION.                                                           | SECOND SESSION.                                                        | SECOND SESSION.                                                                                                                                               |
| Physics : Laboratory Prac-<br>tice.                                       | Physics : Laboratory Prac-<br>tice.                                    | Analytical Mechanics.                                                                                                                                         |
| Mining.<br>Geology.<br>Palæontology.<br>Botany.<br>Zoölogy.<br>Lithology. | Geology.                                                               | Engineering.<br>Sanitary Engineering.<br><br>Mediæval Architectural<br>History.<br>History of Ornament.<br>The Decorative Arts.<br>Practice (Specifications). |
| Metallurgy : Iron, etc.<br>Biology.<br>Drawing.                           | Applied Chemistry.<br>Assaying.<br>Metallurgy : Iron, etc.<br>Biology. | Geology.                                                                                                                                                      |
| SUMMER VACATION.                                                          | SUMMER VACATION.                                                       | SUMMER VACATION.                                                                                                                                              |
| Memoir.                                                                   | Memoir.                                                                | Memoir.                                                                                                                                                       |

FOURTH YEAR.  
Subjects required in the courses of—

| MINING<br>ENGINEERING.                                                    | CIVIL<br>ENGINEERING.                                                                                                                                       | METALLURGY.                                     |
|---------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------|
| FIRST SESSION.                                                            | FIRST SESSION.                                                                                                                                              | FIRST SESSION.                                  |
| Mining.<br>Ore Dressing.<br>Machinery and Mill Work                       | Civil Engineering.<br>Machinery and Mill Work                                                                                                               | Mining.<br>Ore Dressing.                        |
| Mechanical Engineering.<br>Surveying (Railroad).<br>Graphical Statics.    | Mechanical Engineering.<br>Surveying (Railroad).<br>Graphical Statics.<br>Engineering Design.<br>Railroad Engineering.<br>Sanitary Engineering.<br>Geodesy. | Mechanical Engineering.<br>Graphical Statics.   |
| Dynamical Theory of Heat.                                                 | Dynamical Theory of Heat.                                                                                                                                   | Dynamical Theory of Heat.                       |
| Economic Geology.                                                         |                                                                                                                                                             | Economic Geology.                               |
| Metallurgy : Copper,<br>Lead, etc.                                        | Drawing.                                                                                                                                                    | Metallurgy : Copper,<br>Lead, etc.<br>Drawing.  |
| SECOND SESSION.                                                           | SECOND SESSION.                                                                                                                                             | SECOND SESSION.                                 |
| Mining.<br>Ore Dressing.                                                  | Civil Engineering.                                                                                                                                          | Mining.<br>Ore Dressing.                        |
| Machinery and Mill Work<br>Mechanical Engineering.                        | Machinery and Mill Work<br>Mechanical Engineering.<br>Engineering Design.<br>Railroad Engineering.<br>Sanitary Engineering.<br>Geodesy.                     | Mechanical Engineering.                         |
| Dynamical Theory of Heat.                                                 | Dynamical Theory of Heat.                                                                                                                                   | Dynamical Theory of Heat.                       |
| Economic Geology.                                                         |                                                                                                                                                             | Economic Geology.                               |
| Quantitative Analysis.<br>Assaying.<br>Metallurgy : Silver, Gold,<br>etc. | Drawing.                                                                                                                                                    | Assaying.<br>Metallurgy : Silver, Gold,<br>etc. |
| Project or Thesis.                                                        | Project.                                                                                                                                                    | Drawing.<br>Project.                            |



# FOURTH YEAR.

Subjects required in the courses of—

| GEOLOGY AND<br>PALÆONTOLOGY                                              | ANALYTICAL<br>AND APPLIED<br>CHEMISTRY.                       | ARCHITECTURE.                                                                                  |
|--------------------------------------------------------------------------|---------------------------------------------------------------|------------------------------------------------------------------------------------------------|
| FIRST SESSION.                                                           | FIRST SESSION.                                                | FIRST SESSION.                                                                                 |
| Mining.<br>Ore Dressing.                                                 |                                                               | Civil Engineering.                                                                             |
|                                                                          |                                                               | Descriptive Geometry.<br>Stereotomy.                                                           |
| Surveying (Railroad).                                                    |                                                               | Graphical Statics.<br>Engineering Design.                                                      |
|                                                                          |                                                               | Sanitary Engineering.<br>Architectural History,<br>Research.                                   |
| Palæontology.<br>Botany.<br>Zoölogy.<br>Lithology.<br>Economic Geology.  | Economic Geology.<br>Organic Chemistry.<br>Applied Chemistry. | History of Ornament.<br>Theory of Design.<br>Practice (Construction).<br>Economic Geology.     |
| Quantitative Analysis.<br>Metallurgy : Copper,<br>Lead, etc.<br>Drawing. | Metallurgy : Copper,<br>Lead, etc.                            | Design, Problems.<br>Advanced Design.                                                          |
| SECOND SESSION.                                                          | SECOND SESSION.                                               | SECOND SESSION.                                                                                |
| Mining.<br>Ore Dressing.                                                 |                                                               | Stereotomy.                                                                                    |
|                                                                          |                                                               | Engineering Design.                                                                            |
|                                                                          |                                                               | Sanitary Engineering.<br>Architectural History,<br>Research.                                   |
|                                                                          |                                                               | History of Ornament.<br>The Decorative Arts.<br>Practice (Construction).<br>Historical Design. |
| Palæontology.<br>Botany.<br>Zoölogy.<br>Lithology.<br>Economic Geology.  | Economic Geology.<br>Organic Chemistry.<br>Applied Chemistry. | Economic Geology.                                                                              |
| Quantitative Analysis.                                                   |                                                               |                                                                                                |
| Metallurgy : Silver, Gold,<br>etc.<br>Drawing.<br>Thesis.                | Metallurgy: Silver, Gold,<br>etc.<br><br>Thesis.              | Advanced Design.<br>Project.                                                                   |

## POST-GRADUATE COURSES.

## I.—COURSE IN ELECTRICAL ENGINEERING.

FULL COURSE FOR THE DEGREE OF ELECTRICAL ENGINEER.

The full course for the degree of Electrical Engineer occupies two years.

The instruction is arranged as follows:

## FIRST YEAR.

General principles of electricity—static electricity, magnetism, dynamic electricity, electro-magnetism, thermo-electricity, heating, lighting and mechanical effects of electricity, induction, etc.

Mathematical theory of electricity—static and dynamic electricity, magnetism, and electro-magnetism. (Optional.)

Theory of electrical measurements—electrical laws, electrical units and their determination, theory of electrical measuring instruments and methods of measurement.

Practical laboratory work—electrical measurements and tests.

Practice of the dynamo and electric motor—construction, operation, regulation, and testing.

Theory of the dynamo and electric motor—continuous-current machines.

Electric lamps, arc and incandescent.

Telegraph, single needle, Morse, duplex, and printing.

Telephone transmitters and receivers.

Electric batteries, primary and secondary.

Workshop practice in making electrical apparatus.

Drawing, diagrams of circuits, sketches and working drawings of electrical apparatus.

## SECOND YEAR.

Electric lighting—design and installation of plants, regulating apparatus, safety devices, wiring, overhead and underground conductors, managing and testing of stations, laws and regulations relating to electric lighting.

Electric power—generation, transmission, and distribution of electric power, electric railways, electric hoisting, pumping, and ventilating apparatus.

Electric telegraph—quadruplex, multiplex, autographic, and submarine; dynamos in telegraphy.

Electrical methods and apparatus used in the extraction, purification, and deposition of metals and inelectric welding.

Theory of primary and secondary batteries.

Theory of the dynamo and electric motor—alternate-current machines.

Mechanical engineering—

1. Steam-boilers: construction, wear and tear, fittings, setting, testing, care and management, firing, feeding, injectors, pumps, etc.
2. Mechanism of engines: valve gear, governors, etc.
3. Management of engines: erecting, emergencies, etc.
4. Proportions of engines, etc.
5. Testing efficiency of engines and boilers.
6. Pumps, hoisting engines, ventilating machinery.
7. Hot air, gas, and petroleum engines, etc.
8. Machine tools.

Mathematical theory of electricity—theory of alternating and varying currents, electro-magnetic theory of light, and the fundamental relations of electricity, magnetism, light, heat, and mechanical energy. (Optional.)

Practical laboratory work—testing of dynamos, motors, batteries, lines, lamps, etc.

Workshop practice in making electrical apparatus.

Drawing—design and drawing of plans for stations and plants.

Thesis—a graduation thesis on some special electrical subject assigned will be required at the end of the second year.

During both years frequent visits are made to electrical factories, stations, and plants.

#### PARTIAL COURSE OF ONE YEAR FOR CERTIFICATE.

Graduates of colleges and technical schools, and other applicants of adequate attainments and mature age, who are not candidates for a degree, may be admitted to partial courses on giving satisfactory evidence that they are able to pursue with credit and advantage the special topics or studies to which they wish to devote themselves for one year.

## II.—COURSE IN SANITARY ENGINEERING.

#### FULL COURSE FOR THE DEGREE OF SANITARY ENGINEER.

The full course for the degree of Sanitary Engineer occupies two years.

The instruction is arranged as follows:

The general principles of hygiene—causes of diseases, modes of determining their presence and of preventing and destroying them; bacteriology; organization and duties of health authorities; sanitary jurisprudence.

Organic chemistry—general principles and methods of analysis.

Water supply—rainfall, flow of streams, storage of water, quantity required for cities and towns, asylums, hospitals, etc.; impurities of water, their origin and nature, whether occurring at its source, in storage, or in distribution, and methods of purification, by screens, filter-beds, infiltration galleries, chemical processes, etc.; analysis, microscopical and chemical.

Air—composition, its impurities, effect of these on the sanitary condition of cities and towns, hospitals, asylums, public and private dwellings.

Soil—methods of studying the topographical and geological features of a district in reference to the effect of the quality and characteristics of the soil upon the drainage and other sanitary conditions, the locations of cemeteries, etc.

House drainage—water supply and drainage of public buildings and private dwellings, connected with the removal of laundry, sink, and closet refuse; practical elements of plumbing.

Sewage—removal and disposal by various methods, including the frequent and systematic removal from cesspools and privies, accompanied by disinfection and deodorization, by the water-carriage system, pneumatic system, etc., to points of its final disposition; the construction of sewers, including combined and separate systems, outfalls, sea outfalls, tank sewers, ventilation of sewers, etc., final disposition of sewage, garbage, and other refuse by cremation furnaces, irrigation, filtration, chemical precipitation; the construction of plants and machinery for the same, etc.

Ventilation—quantity of air required under various conditions, methods of supplying or renewing air by natural or spontaneous means, by artificial means, including chimneys heated at the base by stoves, or steam coils, and removal by fans or blowers; the determination of proper methods of introducing fresh air, its proper distribution, dimensions of the air conduits, and final rejection.

Heating—the various means of heating by stoves, hot-air furnaces, hot water, and steam, and the most practical



and efficient treatment of problems arising under various circumstances connected with public and private buildings; the construction of the apparatus and the distribution of heat, whether in connection with or independent of the ventilation.

Drainage—the drainage of rural districts for sanitary objects, the surface and subsoil drainage of cities and towns, drainage of sites for country dwellings, barns, and out houses.

Village sanitation—the construction, care, and management of cesspools privies, etc., and their disposition with regard to wells and dwellings; care of streets, gardens, and yards, with reference to the accumulation and removal of refuse; surface and subsoil drainage.

Pollution of streams—remedies to be adopted, and means of prevention.

Arrangements for preventing and ameliorating the unhealthy conditions arising in certain trades and manufactories.

Streets and pavements, as affecting the health of communities.

The principles of heat and thermo-dynamics, applicable to all constructions connected with heating and ventilation, including boilers, radiators, flow of air through conductors, etc.

Inspections—methods of examination of the sanitary conditions of public and private buildings, towns and villages, and of sewers, drains, and water courses; methods of disposal of sewage, and garbage; official inspections by members of boards of health; organizations of health commissions, etc.

Candidates for the degree of sanitary engineer will be required to hand to the professor of engineering, at the end of the course a thesis approved by the faculty, on some subject connected with sanitary engineering, and will also be required to pass satisfactory examinations in the subjects taught.

#### PARTIAL COURSE FOR A CERTIFICATE OF PROFICIENCY.

Graduates of colleges and technical schools, and other applicants of adequate attainments, and mature age, who are not candidates for a degree, may be admitted to partial courses on giving satisfactory evidence that they are able to pursue with credit and advantage the special topics or studies to which they wish to devote themselves for one year.



## UNDER THE UNIVERSITY FACULTY OF MINES.

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### ELECTIVE COURSES FOR THE DEGREES OF MASTER OF ARTS AND DOCTOR OF PHI- LOSOPHY, AND SPECIAL COURSES.

#### I.—DEPARTMENT OF MATHEMATICS.

By Prof. Van Amringe, Dr. Fiske and Mr. Maclay :

1. Advanced course in differential and integral calculus—2 hours a week.
2. Advanced course in solid geometry and higher plane curves—2 hours a week.
3. Modern higher algebra—1 hour a week.
4. General theory of functions—3 hours a week.
5. Abelian functions—1 hour a week.
6. Calculus of variations—2 hours a week for one term.
7. Differential equations (general)—2 hours a week for one term.

#### II.—DEPARTMENT OF MECHANICS.

By Prof. Peck :

1. Higher mechanics—2 hours a week.
2. Determinants and modern co-ordinate geometry—2 hours a week.

By M. I. Pupin, Ph.D. :

1. The principle of conservation of energy and the various methods of its application to the study of physical phenomena.

#### III.—DEPARTMENT OF PHYSICS.

By Prof. Rood :

1. Calorimetry.
2. Radiant heat.
3. Interference of light.
4. Polarized light.
5. Acoustic measurements.
6. Thermo-electricity.

7. Electrical induction.

8. Conversion of electrical energy into light and heat.

Each course will consist of 8 hours of laboratory work a week.

#### IV.—DEPARTMENT OF CHEMISTRY.

By F. G. Wiechmann, Ph.D. :

1. The history of chemical theory—1 hour a week.

By J. S. C. Wells, Ph.D. :

1. Examination of new methods of analysis.

2. Spectroscopic analysis.

3. Analysis of the alkaloids.

4. Electrolytic analysis.

5. Study of special chemical reactions.

Each course will consist of 8 hours of laboratory work a week.

By Prof. Waller :

1. The quantitative relations of the rare elements.

2. Theoretical and industrial relations of iridium.

3. Re-determination of certain atomic weights.

4. The allotropic conditions of certain elements.

5. Quantitative electrolytic analysis.

6. Rapid methods of analysis in connection with metallurgical processes.

7. Rapid methods of analysis in connection with certain processes in industrial chemistry.

8. Special volumetric methods.

9. Chemical examination of textile fibres.

10. Chemical examination of dyes and dyed fibres.

11. Investigation of pigments.

12. Investigation of fats and oils.

13. Investigation of resins.

14. Investigations on organic acids.

15. Investigations on alcohols.

16. The chemical relations of substances in the manufacture of paper.

17. Chemical relations of albumens and albumenoid substances.

Each course will consist of 8 hours of laboratory practice a week.

By Prof. Colby :

1. Organic magnesium compounds.

2. On the action of organic acids on diatomic nitrils.

3. Adipic acid and its formation from aromatic compounds.
  4. The action of thionyl chloride on amides.
  5. Diatomic sulphones.
  6. Electrolysis of certain groups of organic acids.
- Each course will consist of 8 hours of laboratory practice a week.

By F. G. Wiechmann, Ph.D. :

1. Technical sugar analysis—8 hours laboratory practice a week.

By Prof. Ricketts :

1. Special methods of assaying ores.
  2. Special methods of analyzing alloys.
  3. Special methods of analyzing and assaying furnace products.
  4. Quick methods of assaying ores, metals, and furnace products.
  5. Ore testing for the proper selection of methods of treating alloys.
  6. The electrical treatment of ores and metals.
- Each course consists of 8 hours laboratory practice a week.

#### V.—DEPARTMENT OF GEODESY AND PRACTICAL ASTRONOMY.

By Prof. Rees :

1. Practical and spherical astronomy. Lectures 2 hours a week for two years ; and observatory work throughout the same time.
2. The method of least squares and its application to geodesy and astronomy—I hour a week for one year ; and computations of practical examples.

By Prof. Rees and H. Jacoby :

1. Instruction in the theory of the reduction of photographic star plates, with practical application to the Rutherford star photographs.

By H. Jacoby :

2. Theoretical astronomy. Lectures on theory of planetary motions—I hour a week for two years ; and computations of comet orbits, etc.

#### VI.—DEPARTMENT OF BIOLOGY AND MICROSCOPY.

By A. A. Julien, Ph.D. :

1. The fresh water algæ and lower fungi—2 hours a week.

2. Protozoa and their sanitary relations—2 hours a week.
3. Micro-chemistry—2 hours a week.
4. Biological analysis of water and air—4 hours a week.

#### VII.—DEPARTMENT OF BOTANY.

By Prof. Britton:

1. Vegetable anatomy. Laboratory instruction in the preparation and examination of cells and tissues—2 hours a week.
2. Cryptogamic botany. Lectures, herbarium and laboratory instruction in the structure and classification of the ferns, mosses, lichens, higher fungi, and marine algæ—2 hours a week.
3. Morphology of the flowering plants. Instruction by text-book, models, diagrams, and herbarium—1 hour a week.
4. Systematic botany. Determination of species and their relations to each other from printed descriptions, and use of the herbarium—2 hours a week.
5. Economic botany. Illustrated lecture course on drug plants, food plants, fibre plants, and timbers—1 hour a week.
6. Systematic botany. Advanced course. Critical study of an order of genus of plants and preparation of a monograph thereon. Supplementary to Course No. 4. Number of hours a week depending on the group selected—not less than 4 hours a week.
7. Vegetable anatomy. Advanced course. Critical study of the cells and tissues of some plant selected and preparation of a memoir thereon—not less than 4 hours a week.

#### VIII.—DEPARTMENT OF ZOÖLOGY.

By John I. Northrop, Ph.D.:

1. Anatomy. Laboratory work 4 hours a week.
2. Special anatomical work—not less than 4 hours a week.
3. Systematic study of some group of animals—not less than 4 hours a week.

#### IX.—DEPARTMENT OF MINERALOGY AND METALLURGY.

By Prof. Egleston:

1. Higher studies in blowpiping—2 hours a week during one term.



2. Instrumental mineralogy, including the use of goniometers for measuring angles and indices of refraction, the study of polarization, phosphorescence, fluorescence, etc., in minerals, including the method of cutting them—2 hours a week during one term.
3. Advanced studies in combustion, calorimetry, and the behavior of slags—2 hours a week during the year.

#### X.—DEPARTMENT OF GEOLOGY.

By Prof. Newberry :

1. Higher geology—3 hours a week.

#### XI.—DEPARTMENT OF ENGINEERING.

By Prof. Trowbridge :

1. Hydro-dynamics. General laws of motion of liquids and gases, with and without friction; mutual impulse of fluids and solids; work performed by various fluids as sources of power, and laws of efficiency—2 hours a week.
2. Thermo-dynamics. Dynamical theory of heat; principles of thermo-dynamics applied to heat engines, and various engineering problems—2 hours a week.
3. Dynamics of engineering. Laws of dynamics applied to engineering—2 hours a week.
4. Sanitary science. Water supply, sewerage, drainage, disposal of sewage, ventilation, heating—2 hours a week.
5. Rivers, harbors, and breakwaters. Physical characteristics of rivers, estuaries, and harbor bars; methods of improvements; location and construction of breakwaters and other marine works—2 hours a week.
6. Hydraulic motors. Vertical and horizontal water wheels; their construction and efficiency; centrifugal pumps and fans; theory and construction—2 hours a week.

By F. B. Crocker, E.M. :

1. The history of electricity and its influence upon the scientific and industrial progress of the present century—2 hours a week.
2. The direct conversion of the energy of fuel into electricity—2 hours a week.
3. Theory of electrolysis—2 hours a week.
4. The effect of chemical, mechanical and thermal conditions upon the electrical conductivity of metals—2 hours a week.

By Prof. Hutton :

1. Properties of engineering materials.
2. Efficiency of machines.
3. Kinematics: Advanced theorems. Applications to mechanism.
4. Advanced theorems in steam generators.
5. Advanced theorems in engine design.
6. Advanced theorems: use of other fluids than steam for industrial power.
7. Marine engineering.

Each course includes 2 hours a week in the lecture room, and laboratory practice.

## XII.—DEPARTMENT OF MINING.

By Prof. Munroe :

1. Coal mining—2 hours a week.
2. Ore mining—2 hours a week.
3. Coal washing—I hour a week.
4. Ore dressing—I hour a week.
5. Examination of a mineral property or a mine ; four to six weeks devoted to field and underground work in the Summer School of Practical Mining, with conferences at convenience of professor.
6. Examination of a coal-washing plant, or an ore-dressing plant ; four to six weeks' work in the mill and in the laboratory, with conferences.
7. Special problems and original investigations in ore-dressing and mining as assigned, with conferences, laboratory and field work as required.

## XIII.—DEPARTMENT OF ARCHITECTURE.

By Prof. Ware :

1. Architectural history—2 hours a week.
2. Architectural design—2 hours a week.

Each course includes 8 hours a week in the drawing academy.

## DEPARTMENTS OF INSTRUCTION.

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### MATHEMATICS.

The students of the first class attend four hours a week throughout the year. In the first session they are taught trigonometry, plane, analytical, and spherical, with the solution of many practical problems by formulæ and by construction; and the mensuration of surfaces and of volumes. In the second session they complete the subject of algebra, including the general principles and properties of logarithms and the logarithmic series, the general theory of equations, embracing the principal transformations and properties, derived equations and equal roots, Sturm's theorem, and the solution of higher equations; and begin analytical geometry.

The students of the second class attend four hours a week throughout the year. In the first session, they complete the subject of analytical geometry, with applications to lines and surfaces of the second order, and begin the study of the differential calculus; and in the second, they complete the subject of the differential and integral calculus as contained in Newcomb's text-book.

### MECHANICS.

This subject is taught during the third year. The course of instruction embraces the following subjects:

Representation and measurement of forces; composition, resolution, and equilibrium of forces; principles of moments and virtual moments; application to centre of gravity.

Elementary machines: friction, stiffness of cords, atmospheric resistance.

General equations of motion: centrifugal force; vibratory motion; motions of translation and rotation; moment of inertia, principal axes, and ellipsoid of inertia; laws of im-

pact ; centre of percussion ; general theorem of work ; application to fly-wheel.

Mechanics of fluids : application to hydraulic press ; buoyancy and flotation ; application to specific gravity.

Tension and elasticity of gases and vapors : application to pumps ; investigation of the barometer formula ; motion of liquids in pipes and channels ; application to hydraulic ram ; mechanics of capillarity.

### PHYSICS.

The students of the first class are occupied during the first term in the study of sound, heat, and the steam-engine ; during the second term with the subjects of optics, electricity, and magnetism. The courses are fully illustrated by appropriate experiments, and practical problems are occasionally proposed for solution.

To the students of the third class, courses of lectures are delivered on the laws of electrostatics and electrodynamics, electrical units, and dynamo-electrical machines, and on the undulatory theory of light. Laboratory instruction is also given to members of this class.

### CHEMISTRY.

I. GENERAL CHEMISTRY.—The first class, in all courses, attends two lectures a week in inorganic chemistry during the entire year. The class is divided into four sections, each of which recites once a week to the assistant instructor.

During the second term of the first year the students in the course of analytical and applied chemistry attend twice a week in chemical physics.

The second class, in this course, attends four times a week throughout the year in chemical philosophy.

II. ANALYTICAL CHEMISTRY.—There is a laboratory devoted to qualitative analysis, another to quantitative analysis, and an assay laboratory. These laboratories are provided with all the necessary apparatus and fixtures, and each is under the personal supervision of two or more members of the corps of instruction. Each student is provided with a convenient table, with drawers and cupboards, and is supplied with a complete outfit of apparatus and chemical reagents.

During the first year, qualitative analysis is taught by lectures, blackboard exercises, and recitations, and the student is required to repeat all the experiments at his table in the laboratory. The class is divided into four sections, each



of which recites once a week to the assistant instructor. Having acquired a thorough experimental knowledge of the reactions of a group of bases or acids, single members of the group or mixtures are submitted to him for identification. He thus proceeds from simple to complex cases, till he is able to determine the composition of the most difficult mixtures.

When the student shows, on written and experimental examinations, that he is sufficiently familiar with qualitative analysis, he is allowed to enter the quantitative laboratory.

During the second and third years, quantitative analysis is taught by lectures and recitations, and the student is required to execute in the laboratory, in a satisfactory manner, a certain number of analyses. He first analyzes substances of known composition, such as crystallized salts, that the accuracy of his work may be tested by a comparison of his results with the true percentages.

He is then required to make analyses of materials occurring in commerce, or in the applications of technical and sanitary chemistry, metallurgy, etc., as ores, fertilizers, fuel, water, etc., the object being not only to instruct in analytical methods, but also to give, so far as possible, a knowledge of the processes of technical chemistry.

III. ORGANIC CHEMISTRY is taught to the students in the course of analytical and applied chemistry during the fourth year, when they are admitted to the organic laboratory. This instruction continues during the entire year, and consists of lectures, recitations, informal blackboard conferences in the laboratory, and analytical and synthetical work at the laboratory table.

The laboratory work of each student consists of :

1. Ultimate analyses, including determinations of carbon, hydrogen, nitrogen, sulphur, and haloid elements in organic substances; determination of vapor densities, molecular weights, specific gravities, melting and boiling points, and calculation of formulæ.

2. Preparation, by synthesis, of a limited number of organic compounds. The student is taught to apply, experimentally, the reactions learned in the lecture-room, the object being to familiarize him with the various methods of synthesis.

3. Applications of organic chemistry to the arts, especially the use of the artificial coloring matters prepared by the students, such as rosanilin, alizarin, indigo, etc., to dye-

ing and calico printing, and the testing of commercial colors and mordants.

4. A complete but concise memoir on each substance prepared, including its history, preparation, constitution, properties, applications, and a list of references to its literature.

5. A thesis on some subject assigned by the professor in charge.

IV. ASSAYING.—During the third and fourth years, the student is admitted to the assay laboratory, where he is provided with a suitable table and a set of assay apparatus, and where he has access to the sampling and ore-testing machinery, crucible and muffle furnaces, and to volumetric apparatus for the assay of alloys.

The course includes :

1. Lectures and recitations.
2. Practical work.

The lectures treat of and describe the furnaces, fuels, apparatus, reagents, etc., employed, and explain the general principles as well as the special methods of sampling and assaying. Models and lantern views of the furnaces and apparatus are shown, and the ores of the various metals and the appropriate fluxes are exhibited and described. The recitations follow the lectures, and are held by the assistant instructor, the class being divided into small sections for the purpose.

The practical work includes the testing of reagents and small samples of ore, practice on methods, and special work to familiarize the student with sampling large lots of ore, and to give practice in mill and furnace assay.

The student is supplied with the different ores, and is required to assay each, under the immediate supervision of the instructor.

V. APPLIED CHEMISTRY.—The instruction in applied chemistry extends through the second, third, and fourth years, and consists of lectures and recitations illustrated by experiments, diagrams, and specimens. Wagner's *Chemische Technologie* is used as a text-book.

The subjects discussed are :

#### IN THE SECOND YEAR.

(For all students.)

1. Air: nature, sources of contamination, sewer gas, plumbing, draining, disinfection, ventilation.

2. Water: composition of natural waters, pollution, disposal of sewage and house refuse.
3. Artificial illumination: candles, oils, and lamps, petroleum, gas and its products, electric light.
4. Photography.
5. Limes, mortars, and cements.
6. Building stones: decay and preservation.
7. Timber and its preservation: pigments, paints, essential oils, varnishes, preserving processes.
8. Glass and ceramics.
9. Explosives: gun-powder, gun-cotton, nitro-glycerine, etc.
10. Electro-metallurgy.

#### IN THE THIRD AND FOURTH YEARS.

(For students in the course of analytical and applied chemistry.)

1. Chemical manufactures: acids, alkalies, and salts.
  - (a) Sulphur, sulphurous acid, hyposulphites, sulphuric acid, bisulphide of carbon, etc.
  - (b) Common salt, soda ash, hydrochloric acid, chlorine, binoxide of manganese, bleaching powder, chlorates, chlorimetry, etc.
  - (c) Carbonate of potash, caustic potash.
  - (d) Nitric acid and nitrates.
  - (e) Iodine, bromine, etc.
  - (f) Sodium, aluminium, magnesium.
  - (g) Phosphorus, matches, etc.
  - (h) Ammonia salts.
  - (i) Cyanides.
  - (j) Alum, copperas, blue vitriol, salts of magnesia, baryta, strontia, etc.
  - (k) Borates, stannates, tungstates, chromates, etc.
  - (l) Salts of mercury and silver.
  - (m) Oils, fats, soaps, glycerine.
2. Food and drink: milk, cereals, starch, bread, meat, tea, coffee, sugar, fermentation, wine, beer, spirits, vinegar, preservation of food, etc.
3. Clothing: textile fabrics, bleaching, dyeing, calico printing, paper, tanning, glue, india-rubber, gutta-percha, etc.
4. Fertilizers: guano, superphosphates, poudrettes, etc.

## GEOLOGY AND PALÆONTOLOGY.

The course of instruction in this department is as follows :

## FIRST YEAR.

Botany, as an introduction to palæontology—lectures throughout the year.

## SECOND YEAR.

Zoölogy, as an introduction to palæontology—lectures throughout the year.

## THIRD YEAR.

Lithology: minerals which form rocks and rock masses of the different classes—lectures and practical exercises.

Geology: cosmical, physiographic, and historical—lectures and conferences throughout the year.

## FOURTH YEAR.

Economic geology: theory of mineral veins; ores; deposits and distribution of iron, copper, lead, gold, silver, mercury, and other metals; graphite, coal, lignite, peat, asphalt, petroleum, salt, clay, limestone, cements, building and ornamental stones, etc.—lectures and conferences throughout the year.

## MINERALOGY AND METALLURGY.

I. MINERALOGY.—The studies in mineralogy, except for students in the course of civil engineering, continue throughout the first and second years. The instruction for civil engineers is given in the second year of the course, and is especially directed to the minerals of building stones.

The subjects studied are :

Blowpipe analysis, as an introduction to mineralogy—lectures, conferences, laboratory work throughout one term. The collection of blowpipe substances consists of 300 compounds, exclusive of minerals.

Crystallography, as an introduction to mineralogy—lectures and conferences, one half term for civil engineers, one term for students in other courses. The collections consist of over 600 models in wood, 150 models in glass, and the species in the mineral collections are most of them illustrated by wooden models, and by actual crystals.



Mineralogy—lectures, conferences, and laboratory work throughout one term for civil engineers, and throughout one year for students in other courses. Students have access to a collection of over 3,800 carefully labelled specimens, and also, under the supervision of the instructors, are allowed to handle a collection of 2,500 finer specimens. They have besides constant access to the cabinet of minerals, which contains about 20,000 specimens.

II. METALLURGY.—The lectures in metallurgy continue through two years, and discuss in detail the methods in use for working ores in the best establishments in this country and in Europe. They include:

1. General metallurgy.
2. The metallurgy of iron.
3. The metallurgy of steel.
4. The metallurgy of copper, lead, silver, gold, zinc, tin, mercury, etc.

It is designed to make these lectures as practical as possible, and for this purpose the economic details of cost are given whenever they can be obtained from authentic sources. Special attention is given to the ores of this country which are difficult to treat, to the solution of practical problems which may occur, and to changes which different economic relations are liable to cause in the treatment of the same ore in different localities.

In addition to the lectures by the head of the department the students in the course of metallurgy receive each week, from one of the assistants, a thorough review of work of the week. A certain number of hours are also devoted to questioning the entire classes and further explaining points not thoroughly understood.

Over a thousand lecture diagrams and the same number of photographic illustrations for use in the lantern have been prepared to illustrate the furnaces, machines, and appliances used in the different metallurgical works, as well as to illustrate the construction of furnaces, etc.

The collections illustrating the department of metallurgy include models of furnaces and a very large number of drawings and tracings, in most cases copies from the working drawings of establishments in actual operation. This collection embraces several hundred tracings collected from the best types of works in this country and abroad, many of them being sufficiently detailed to be used as construction drawings.

The metallurgical collection, properly speaking, em-

braces about 3,000 specimens, illustrating every stage of many prominent metallurgical processes. Many of these specimens have been analyzed or assayed. They are open to the inspection of the students.

As an application of the lectures, the students are required to work out a project, and to present working drawings and estimates for the erection of works to treat a given ore under stated conditions. The problems given are those which require solution in some parts of the United States.

## ENGINEERING.

In the department of Engineering are included :

1. Drawing, descriptive geometry, and graphics.
2. Surveying.
3. Civil and mechanical engineering.
4. Electrical engineering.
5. Sanitary engineering.

I. DRAWING, DESCRIPTIVE GEOMETRY.—The course in drawing of the first and second years embraces instrumental drawing, descriptive geometry, shades, shadows, and perspective, isometric drawing, topographical and geological drawing, drawings of engineering constructions and machinery.

Drawing of the third and fourth years is so planned as to teach the nature of structural design. The use of working drawings as a means of specification for construction receives special attention.

The course includes work from bridges, roofs, machines, and miscellaneous structures in New York and vicinity. Reference is had to blue prints, donated by various bridge works and engineering offices, in order to show the student the manner of making practical working drawings. He is then required to go into the field and take sketches, and from these to make complete working drawings in the drawing-room.

The drawing and engineering design of the fourth year are intimately connected. A variety of stress sheets of graphic statics are first drawn, and the remainder of the time is devoted to the designing of engineering structures along the lines described in the lectures on the subject, including the making of bills of materials and complete working drawings.

II. SURVEYING.—The instruction in surveying is given in a special summer class during the vacations between the first and second and between the second and third years.

Ten or twelve weeks in all are devoted to practical work in the field, supplemented by lectures and instruction in the theory of surveying, and office-work for the computation of surveys and construction of maps.

The students are divided into squads of two men, each squad being provided with instruments, and are required to execute a certain number of surveys. Each survey is preceded by class exercises, intended to familiarize the student with the details of the work, and each survey forms the subject of a report, with computations and maps.

At first these exercises are without instruments, the students being drilled in methods of ascertaining distances and making rough surveys by pacing, and by employing the height of the body, the length of the arm, and the like, for making measurements when instruments are not available.

These exercises are followed by others with the use of chain, sight-poles, hand-level, and other equally simple forms of apparatus, and by a topographical survey, showing the application of rough and rapid methods of work for reconnaissance surveys which demand approximate accuracy only. Next the students make surveys with the ordinary surveyor's compass and chain, and with the solar compass, and magnetic surveys with the attraction compass and dipping needle.

Finally, they are practised in the adjustments and use of the more accurate instruments, including field-work in triangulation, traversing, and levelling, and surveys with the plane table.

The following exercises and surveys are required of each squad of students:

1. Exercises for determining length of pace, and for practice in pacing.
2. Survey of a field by pacing.
3. Exercises in sketching contour lines, and topographical details—two examples.
4. Exercises in chaining over level and sloping ground, and in construction of right angles and parallel lines with chain.
5. Exercises in ranging straight lines with sight-poles under different conditions.
6. Exercises in reading compass bearings.
7. Survey, with compass and chain, of a farm of about twenty acres, including location of fences, roads, and farm buildings, correction of bearings for local attraction, computation of latitudes, departures and area, and a plat.



8. Adjustment of hand-level and exercise in levelling.
9. Topographical survey on rectangular plan, with compass, chain, and hand-level, determining minor details by pacing, with finished map of area surveyed.
10. Adjustments of the transit.
11. Triangulation. As an exercise for practice in the use of the transit, each squad is required to make three or four sets of readings of each angle of a triangle, each set including six repetitions.
12. Determination of true meridian by observation on Polaris.
13. Traverse of a polygon of about twelve sides, the angles being repeated and the sides measured with a steel tape, with allowances for catenary, temperature, and inclination. Computation of ordinates and abscissas, and a plat.
14. Adjustment of telemeter wires and measurement of distances by telemeter.
15. Azimuth traverse of a polygon, distances by telemeter readings.
16. City survey. Exercise in laying out city lots and in determining exact position of house and fence lines—report and plat.
17. Adjustments of the wye level.
18. Line of levels, about one mile in length, determining levels of stations 100 feet apart, and of benches.
19. Plane-table survey. Each squad of two men is required to make a survey of about 70 acres, determining all topographical details, and locating contours 20 feet apart.
20. United States mineral survey, with the solar compass, of a mining claim 150 feet by 1500, complying with the requirements of the Land Office and the instructions of the Surveyor-General.
21. Hydrographic survey. For this survey the squads are increased to six men, and each squad is required to survey about 30 acres, making about 250 soundings, each sounding being located by two transits.

The mining-claim survey is required only of students in the courses of mining engineering and metallurgy, and the hydrographic survey of students in the course of civil engineering.
22. A magnetic survey with attraction compass and dipping needle, and a stratigraphic survey, with construction of geological sections and lines of outcrops, may replace, for students in mining engineering, one or more of the exercises above noted.



A supplementary course in topographical surveying has been organized, including odometer work, surveying by photography, and the use of the transit and plane-table in reconnoissance surveys; with the determination of heights and contours by different methods. This course is optional.

During the fourth year a line of railroad is surveyed; locating the line on the ground, setting grade and slope stakes, levelling, and calculating cuttings and embankments, with drawings and estimates. In addition, the course in railroad engineering for the civil engineers embraces practical lectures on railroad construction, permanent way, rolling stock, motive power, including a complete study and design of the locomotive engine in its various types, and administration of railroads, with instruction in the economics of location and transportation.

III. CIVIL ENGINEERING.—Instruction in civil engineering extends through the four years.

During the first year instruction in surveying is given. During the second year instruction is given in the construction of roads and pavements. •

During the third year, the more simple elements of civil engineering are taught. The various subjects are considered in the following order: *first*, materials—building stones, limes, cements, mortar, concrete, brick, wood, metals; their properties and general qualities, mode of preparation, their respective uses, and combinations in construction, their strength and durability; *second*, masonry—construction of masonry, foundations and superstructure, etc.; *third*, framing—structures of wood, carpentry; *fourth*, theory of stresses in structures of wood and iron, with applications to beams, girders, roofs, and pillars.

The course of civil engineering in the fourth year embraces the principles of mechanics applied to engineering constructions and to machinery, the strength of materials, the theory of retaining walls and arches; the principles of hydraulics applied to the improvements of rivers, the water supply of towns, reservoirs, and dams; and the general principles of sanitary engineering, drainage, sewers, house drainage, and ventilation; heat and heat-engines; the dynamics of engineering, water wheels, pumps and pumping engines, steam boiler construction, kinematics, machinery construction; the transmission of power.

The afternoons during the fourth year, are devoted to the application of the principles of engineering to the

designing of various structures, such as roofs, cranes, machinery, and bridges.

Various types of design are explained, both in theory and in construction, and the student is required to determine the stresses for specific problems, to dimension the various parts, to design the connections, and to make thorough working drawings, also to prepare bills of material, order bills, and the like.

A course of lectures, fifty or sixty in number, is delivered during the third year on the properties of the metals used in engineering constructions. These lectures are devoted principally to iron and steel, but include also other metals and alloys. They treat of the mechanical processes by which these metals are transformed into the shapes required by the engineer, from the crude state in which they are found, after reduction by metallurgical processes from their ores. The physical properties of such fabricated materials, under the various uses and conditions to which they are subjected in engineering construction, are also discussed. The lectures are intended to cover, as far as possible, a field of knowledge which of late years has grown into great importance and prominence as an essential branch of an engineer's acquirements, and which connects the science of metallurgy with the art and practice of engineering. This field embraces not only the arts of fabrication of merchant forms, but also the physical and mechanical properties of the metals in such forms: such as coefficients of strength, limits of elasticity, ductility, adaptability for particular uses and different conditions, which vary greatly with the processes through which the metals have passed, and yet from their nature require to be treated in connection with engineering problems. Instruction is also given in inspection and testing of these materials delivered under contract, embracing the usual practical physical tests, and the relations, so far as known, between chemical analysis and physical characteristics.

In view of the paramount importance of iron and steel to the engineer of to-day, considerable time is devoted to these metals, the following topics being specially discussed: the inspection and grading of pig-iron, and the suitability of different grades for various kinds of castings; cupola furnaces and cupola mixtures and their effects upon product; special dangers inherent in castings of certain shapes; principles in design of castings; shrinkage strains and lines of weakness in castings; defects due to cores and

to moulds ; resistance of cast-iron to corrosion and protection from it ; inspection of castings—these are included in a first series.

Chilled castings—their characteristics, uses, production, and dangers—and malleable castings are similarly treated, including their action under heat and under tools, and the brazing of castings.

Under the head of wrought iron are discussed : piling, heating, and rolling of muck bar ; effects of heating and rolling on merchant bar ; forge uses and tests of bar ; requirements of metal for plate, for tube, for wire, and for special forged shapes, such as bolts ; heating, piling, and rolling for shapes or structural iron ; points of defect, characteristics of different shapes, adaptability for different uses ; possible sections and areas ; combination of sections ; protection from corrosion ; inspection of structural iron ; fabrication of ship and boiler plate ; methods and processes, properties, defects, requirements, and inspection ; fabrication of tube and pipe, lap and butt welded ; continuous and universal mills, bending, welding, and straightening rolls, swaging, testing, and tool work ; fittings, forms, and uses.

Under the head of steel are treated : properties of crucible steel resulting from its manufacture, such as uniformity of temper, adaptability for tools and cutters ; Bessemer and Siemens-Martin steels ; properties of ingot metals, mill and furnace treatment for shapes, springs, tires, bars, and plate ; characteristics of ingot plate, effects of alloying impurities ; steel castings : their production, characteristics, and defects ; iron and steel forging ; drop forging, die forging, machine forgings, large and small, heating and handling, excellences and sources of defects ; burnt iron and steel.

Incidentally to these topics is discussed the machinery for handling the materials in process of manufacture, so far as they are essential to the primary object in view.

After iron and steel, follow lectures upon a similar plan, discussing brass, cast, rolled, and drawn ; copper, sheets and tubes ; lead, pipe and sheets ; zinc and tin, sheet and tube, and galvanized and tin plate ; certain alloys for special needs against friction and corrosion. The brazing and soldering processes for the various metals receive attention at the close.

The students in the civil-engineering course are also instructed in the principles of mechanism, beginning with the general theory of motion ; the principles of transmission of motion, the various modes of mechanical connection, the



calculation of relative velocities of moving pieces of machinery, valve-gearing, and the mechanism, movements, and construction of machinery in practice; the dynamics of machinery, or the determination of the relations between the forces which act upon machines and the general application of mechanics to machines; the study of prime movers, including steam-engines, hot-air engines, and water-wheels; the theory and construction of steam-boilers, and the general principles of heat as applied to air and vapors.

### MINING.

The course of instruction in mining extends through the second, third, and fourth years, and includes lectures on excavation, tunnelling, mining, and ore dressing, and work in the summer school of practical mining.

In the second year two hours per week are given to lectures on excavation and tunnelling. These lectures are attended by students of mining engineering and of civil engineering and are intended to cover subjects of common interest to the two professions. The course serves also as an introduction to the lectures on mining of the third and fourth years.

The course deals with:

Excavation of earth, tools and methods employed, support of excavations, excavation in quicksand, mechanical excavators, and the handling and transportation of excavated material.

Dredges—hydraulic, endless chain, scoop, and clam shell; description of machines and methods for canal, river, and harbor work, and the handling of dredged material.

Excavation of rock—hand, and machine drills, explosives, methods of blasting, mammoth blasts, submarine blasting.

Quarrying—plant and methods for quarrying different rocks.

Methods of excavating and timbering tunnels, handling and transportation of excavated material, lighting and ventilation of tunnels, submarine tunnels, permanent lining of tunnels, accidents in tunnelling, location of tunnels.

The lectures on mining extend through the third year, four hours per week, and through the first term of the fourth year, three hours per week.

The course deals with:

Mineral deposits, characteristics of beds, masses, veins, and other deposits, and the irregularities and disturbances to



which they are subject, as affecting the work of exploration and mining.

Examination of mineral properties, relation of topography to geological structure, construction of maps and sections, and tracing of probable outcrops as a guide to exploration.

Prospecting by ditches, pits, and deep boring.

Development, choice of methods, location of openings, sinking of shafts and slopes, driving of tunnels and drifts. Special methods for quicksand and watery strata.

Working of deposits and support of excavations; methods applicable to deposits of different thickness, inclination, and character. Coal mining, vein mining, working of thick deposits and soft-ore bodies. Support of special excavations.

Extraction, methods and machinery, handling mineral in working places, for underground haulages, for hoisting, and for ascent and descent of workmen.

Surface handling and transportation, arrangements for loading and unloading cars and vessels and for storing of minerals. Mineral railroads.

Drainage, sources of mine waters, methods for the control and raising of water; dams, drainage levels, and pumping plant.

Ventilation, air of mines, mine gases, apparatus and methods of ventilation, control and measurement of air currents.

Accidents to men in shafts, levels, and working places; fire-damp and dust explosions; mine fires; inundations; rescue and relief of men.

Administration, organization, and business management, mine accounts and cost sheets.

Examination and valuation of mines.

The summer school of practical mining is held in June and July in the vacation between the third and fourth years, and lasts six weeks. The course of instruction includes four or five weeks' detailed study of the plant and methods of working at some important mine, excursions to other mines and mining regions, and practice in field geology and underground surveying.

The lectures on ore dressing are given in the second term of the fourth year, four hours per week. The course includes the general principles and theory of dressing; preliminary operations; hand dressing; cleansing; crushing; jigging with and without preliminary sizing; slime concentration, and description of typical dressing works.

## BIOLOGY AND HYGIENE.

The object of this course is to give such instruction as to the laws of life and health, the structure of the human body, the general principles of hygiene, first help in accidents and injuries, etc., as should be possessed by every well-educated professional man.

The instruction is given to students in all the courses during the second year, by lectures and recitations, illustrated by diagrams and models.

The subjects discussed are :

General laws of life; human longevity; vital statistics, methods of computation and tabulating; first help in injuries, handling and carrying wounded; burns and scalds, poisons; hemorrhage, wounds, first dressings; exercise, training; animal heat, production, regulation; the skin and its functions.

Causes of disease: heredity, race, diathesis, climate.

Bacteria: classification, culture, disinfection, modes of dealing with contagious diseases.

Food, diets, adulterations, dangerous meats, milk, canned foods, legislation on food.

Respiration: suffocation, drowning, artificial respiration, working in compressed air, effluvia and noxious gases, offensive trades, dusts.

Ventilation: heating in assembly halls, churches, hospitals, theatres, habitations.

Water supply: analysis, biological and chemical, pollution of streams, purification of water, ice and its impurity, jurisprudence of running streams.

Refuse disposal: cremation furnaces, sewage, composition and disposal, sewers, combined and separate systems, house drainage, traps, water-closets, plumbing regulations.

Streets and pavements from a sanitary point of view.

Care of the dead: cemeteries, mortuaries, crematories.

Sanitary jurisprudence, law of nuisance, board of health, quarantine.

MICROSCOPY.—Practical instruction in the use of the microscope is given. Laboratory instruction with lectures for four hours each week is given throughout the second and third years.

The biological laboratories are supplied with all apparatus required for microscopical manipulation, for those branches of biological study needed in sanitary investigation, and for photo-micrography. A separate culture-room has been fitted up for bacterial examinations.

## GEODESY AND PRACTICAL ASTRONOMY.

Instruction in geodesy and practical astronomy during the third year embraces:

1. Text-book work, using Peck's Astronomy and Optics; also lantern lectures on the following subjects, viz.: ancient astronomical instruments; telescopes; solar system; the moon; the sun; Mercury and Venus; the planetoids; Mars, Jupiter, and Saturn; Uranus and Neptune; comets and meteors; stars and nebulae; cosmogony.

2. Text-book work in geodesy.

3. Lectures on the figure of the earth; theodolites for geodetic work; micrometer-microscopes, etc.; eccentricity and errors of graduation; monuments and signals; base apparatus; measurement of base lines; methods of observing angles.

4. Lectures in the observatory on the instruments; also opportunities for viewing the heavens.

During six weeks of the summer vacation, at the close of the third year, the students in civil engineering are required to attend the summer school in practical geodesy.

Instruction in geodesy is continued in the fourth year by:

1. Text-book work, using Doolittle's Practical Astronomy, and also by

2. Lectures on: pendulum observations; magnetic observations; and method of "least squares."

3. The observatory is open for the deeper study of the ordinary astronomical instruments.

## ARCHITECTURE.

During the first and second years, the time which is given in other courses to laboratory work is in this course given to architectural drawing. This is so laid out as to include exercises in the ordinary processes of draughtsmanship, the making of plans, elevations, sections, and details, both on a large and on a small scale; the use of pencil and pen, brushes and colors, with auxiliary exercises in tracing and sketching. The examples are so chosen as to make the student familiar with the commonplaces of architectural form, and are accompanied by lectures upon the elements of architecture, in which the forms and proportions of the Greek and Roman orders, of doors and windows, arches, staircases and balustrades, domes and vaults, roofs and spires, are set forth, and the best ways of drawing them explained. These lectures and exercises are supplemented



by special courses on perspective, and on shades and shadows.

During the second year the students of architecture complete the course of elementary studies in mathematics, physics, and chemistry, given in the department of engineering.

Besides the lectures upon hygiene in the second year, a special course upon sanitary engineering is given to the students of architecture in the third and fourth years. This course covers the drainage of buildings, the disposal of household refuse, ventilation and heating.

In the third and fourth years the study of scientific construction is pursued in connection with the classes of engineering, most of the time, however, being given to strictly professional work.

The study of architectural history is pursued according to the following plan: In the first year a series of illustrated lectures is given upon Egyptian, Assyrian, Greek and Roman architectural history, besides a course of reading on classic archæology and architecture from French and German text-books.

The architecture of the middle ages and that of the renaissance and its more modern derivatives is then taken up in alternate years. On completing the study of ancient architecture, in the first year, one class goes on directly to that of the middle ages in the second year, and to that of the renaissance in the third. The next class passes at once from ancient classical architecture to modern, finishing with the mediæval styles.

During the first half of the year the ground is covered by a course of lectures, and it is reviewed during the second half of the year, the class preparing a series of reports with illustrative drawings followed by exercises in historical design.

Under the general head of ornament, etc., is comprised the study of the decorative details of the different architectural styles, and of the contemporary forms in other branches of art, especially the decorative arts employed in building. The materials and processes employed in these arts, and the theory of æsthetics, in form and color, come under this head.

Under the head of architectural practice is classed the subject of specifications and working drawings, so far as they can profitably be studied in such a school, and of the materials and processes employed in building operations.

Under the head of drawing and design are comprised the practice in original composition afforded by the working



out of problems in design, from given data, and general exercises in draughtsmanship.

In the fourth year those students who prefer to do so may, with the consent of the professor of architecture, substitute for engineering design, sanitary engineering and practice, an equivalent amount of work in architectural history and design.

The students give a certain proportion of time to exercises of a critical and literary character, designed to afford practice in both reading and writing.

Besides the excellent provision in the college library, itself, and in the Avery Architectural Library, the department has a special collection of prints and drawings, about 700 books, and about 12,000 photographs.

University courses in architectural history and design have also been established in this department and corresponding courses in engineering design and practice will follow. It will then be practicable for men who elect design in their fourth year to take another year, either at once or after an interval of office work, for the study of construction and practice, and for those who have elected these studies before graduating to take an extra year of history and design. Such students may be candidates for the degree of master of arts.

The University course in history and design is now open. For fellowships in architecture, see page 71.

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## VACATION WORK.

### MEMOIRS.

During the vacations following the close of each year, memoirs on subjects which will be assigned are required of students as follows: of students in the courses of analytical and applied chemistry, and of architecture, at the close of each year; of students in the course of geology and palæontology, at the close of the third year. The time specified for the completion and handing in of memoirs in chemistry is November 1st in each year; for other memoirs the time specified is the second Monday in October.

### SUMMER SCHOOL IN MECHANICAL ENGINEERING.

During the vacation at the end of the second year, a volunteer class in practical mechanical engineering is usually formed from among the students of either of the engineer-

ing courses who have completed their second year, for the purpose of visiting foundries and machine-shops in the city, and engaging in practical work and study. This class is under the immediate supervision of the professor of mechanical engineering, and is occupied in this way in the month of June.

#### SUMMER SCHOOL IN SURVEYING.

During the latter part of the vacations, between the first and second years, and between the second and third years, students of the engineering, metallurgical, and geological courses are required to attend the summer class in surveying for study of that subject, and to engage in practical surveying work in the field, under the direction of the adjunct professor of civil engineering.

#### SUMMER SCHOOL IN PRACTICAL MINING.

During the vacation at the end of the third year, a class in practical mining, composed of students in the course of mining engineering, and in the course of metallurgy, who have completed the third year, is required to visit mines for practical mine work. This class is under the immediate superintendence of the adjunct professor of mining, and is occupied in this way about six weeks.

#### SUMMER SCHOOL IN PRACTICAL GEODESY.

During the vacation at the end of the third year, a class in practical geodesy, composed of students in the course of civil engineering who have completed the third year, is required to make a geodetic survey of some region. This includes measuring a base line with a United States Coast Survey secondary base apparatus; secondary and tertiary triangulation with eight-inch theodolite; determinations of time and azimuth, using portable transit and theodolite; approximate determinations of time, latitude, and longitude, with sextant. The class is under the immediate supervision of the professor of geodesy and practical astronomy. (See page 58.)

## TEXT-BOOKS.

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Books preceded by an asterisk (\*) are optional—the others are indispensable.

### FIRST CLASS.

Davies' Legendre.  
Peck's Conic Sections.  
Peck's Manual of Algebra.  
Peck's Analytical Geometry.  
Church's Descriptive Geometry.  
Binn's Orthographic Projection.  
Egleston's Diagrams of Crystals.  
Atkinson's Ganot's Physics.  
Fownes' Manual of Chemistry.  
Fresenius' Qualitative Analysis.  
Plattner's Blowpipe Analysis.  
Bastin's College Botany.  
Collignon's Archéologie Grecque.

### SECOND CLASS.

Peck's Analytical Geometry.  
Peck's Practical Calculus.  
Mahan's Stone-Cutting.  
Gillmore's Roads and Pavements.  
Church's Shades and Shadows.  
Egleston's Lectures and Tables of Mineralogy.  
Egleston's Diagrams of Crystals.  
Wagner's Chemische Technologie.  
Cairns' Quantitative Analysis.  
Reber's History of Ancient Art.  
Kroker's Katechismus der Archæologie.  
Nicholson's Manual of Zoölogy.

### THIRD CLASS.

Peck's Analytical Mechanics.

Peck's Astronomy and Optics.  
 Davies' Surveying (revised edition).  
 Johnson's Surveying.

\*Publications of the U. S. Coast and Geodetic Survey relating to the fundamental geodetic operations.

\*Davis' Formulæ for Railroad Earthwork.  
 Searle's Henck's Field-Book for Engineers.  
 Gillmore's Roads and Pavements.

Stoney's Theory of Stresses.

Rankine's Civil Engineering.

\*Mahan's or Wheeler's Civil Engineering.

Rankine's Machinery and Mill Work.

\*Callon's Lectures on Mining.

Egleston's Tables of Weights, Measures, Coins, etc.

Egleston's Metallurgical Tables.

\*Kerl's Metallurgy.

Ricketts' Notes on Assaying and Assay Schemes.

Cornwall's Blowpipe Analysis.

Plattner's Blowpipe Analysis.

Cairns' Quantitative Analysis.

Johnson's Fresenius' Quantitative Analysis.

Wagner's Chemische Technologie.

Dana's Manual of Geology.

Nicholson's Palæontology.

Von Cotta and Lawrence's Rocks.

#### FOURTH CLASS.

\*Text-book of Least Squares, by Merriman.

\*Wright's Treatise on Adjustment of Observations.

\*Clarke's Geodesy.

\*Helmert's Mathematischen und Physikalischen Theorien der Höher Geodäsie, two volumes.

\*Jordan's Vermessungskunde, two volumes.

Doolittle's Practical Astronomy, as applied to geodesy and navigation.

\*Publications of the U. S. Coast and Geodetic Survey, relating to the fundamental geodetic operations.

Henck's Field-Book for Engineers.

Greene's Graphical Statics.

Weisbach's Mechanics of Engineering.

Rankine's Civil Engineering.

Rankine's Prime Movers.

Rankine's Machinery and Mill Work.

\*Rigg on the Steam-Engine.



- \*Goodeve on the Steam-Engine.
- \*Welsh's Designing Valve Gearing.
- Latham's Sanitary Engineering.
- Sewers and Drains for Populous Districts, by J. W. Adams.
- Fanning's Water-Supply Engineering.
- \*Stevenson on Canals and Rivers.
- \*Stevenson on Harbors.
- Parson's Manual of Permanent Way.
- \*Colyer's Hydraulic Lifting and Press Machinery.
- \*Röntgen's Thermodynamics, DuBois' translation.
- \*Planât on Warming and Ventilation.
- \*Joly's Warming and Ventilation.
- \*Callon's Lectures on Mining.
- \*Evrard's Exploitation des Mines.
- \*Haton de la Goupilliere, Exploitation des Mines.
- \*Serlo's Bergbaukunde.
- \*Köhler's Bergbaukunde.
- Kunhardt's Ore Dressing.
- \*Rittinger's die Aufbereitungskunde.
- \*Gaetschmann's Aufbereitung.
- \*Cotta's Treatise on Ore Deposits, by Prime.
- Page's Economic Geology.
- Burat's Géologie Appliquée.
- D'Orbigny's Palæontologie Élémentaire.
- \*Whitney's Metallic Wealth of the United States.
- Egleston's Metallurgical Tables.
- Egleston's Metallurgy of Gold, Silver, and Mercury.
- \*Kerl's Probirkunst.
- \*Allen's Introduction to the Practice of Commercial Organic Analyses.
- \*Berthelot's Leçons sur les Methodes Générales de Synthèse en Chimie Organique.
- \*Berthelot et Jungfleisch's Traite Élémentaire de Chimie Organique.
- \*Roscoe and Schorlemmer's Treatise on Chemistry (Organic Chemistry).
- \*Strecker's Short Text-book of Organic Chemistry by Wislicenus.
- \*Beilstein's Handbuch der Organischen Chemie.
- Levy's Organische Präparate.

## POST-GRADUATE CLASS.

Thompson's Elementary Lessons in Electricity and Magnetism.

Stewart and Gee's Elementary Practical Physics, Vol. II.  
Thompson's Dynamo-Electric Machinery.

\*Watson and Burbury's Electricity and Magnetism.

Fleming's Alternate Current Transformer.

Urquhart's Electric Light Fitting.

Kapp's Electric Transmission of Energy.

Pope's Modern Practice of the Electric Telegraph.

\*Maxwell's Treatise on Electricity and Magnetism.

\*Gore's Electrolytic Separation of Metals.

\*Salomon's Management of Accumulators.

Reuleaux' Theoretische Kinematik.

\*Reuleaux' der Constructeur.

Weisbach-Herrmann's Mechanics of Machinery.

Rankine's Ship-Building.

Seaton's Marine Engines.

Unwin's Testing Materials of Construction.

Kirkman's Treatises on Railroad Accounts and Revenue.

## LIBRARY.

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The library is open to all officers, students, and graduates, for borrowing and reference, daily, except Sundays, Good-Friday, Fourth of July, Thanksgiving day, and Christmas, throughout the year, including all other holidays and vacations.

It contains 120,000 volumes, and additions are yearly made. The library of the N. Y. Academy of Science, Townsend's Civil War Record, and the library of the Huguenot Society are on deposit in the library rooms and are accessible to readers. More than 700 different serials, including the leading periodicals, transactions of societies, etc., are regularly received.

In memory of the late Henry Ogden Avery, an architect of New York, his parents, Mr. and Mrs. Samuel P. Avery, have established in the college a special library of architectural books, and have provided a fund for its increase. To these they have added their son's own professional library.

The Avery Architectural Library offers unusual advantages to students of art and of architecture and to practising architects, to all of whom it is always accessible.

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## CABINETS AND COLLECTIONS.

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Collections of specimens and models, illustrating all the subjects taught in the school, are accessible to the students, including:

Crystal models.

Natural crystals, pseudomorphs.

Ores and metallurgical products.

Models of furnaces.

Collection illustrating applied chemistry.

Fossils.

Economic minerals.

Rocks.

The herbarium and other botanical collections.

The zoölogical collections.

Olivier's models of descriptive geometry.

Models of mechanical movements.

Models of mining tools.

Models of mining machines.

Casts, antique statuary, animals, etc.

CRYSTAL MODELS.—The lectures on crystallography are illustrated by a collection of 150 models in glass, which show the axes of the crystals and the relation of the derived to the primitive form. This suite is completed by 400 models in wood, showing most of the actual and theoretical forms, and also by a collection of natural crystals showing the forms as they actually occur in the prominent mineral species.

MINERALS.—The cabinet of minerals comprises about 30,000 specimens, arranged in cases. It includes a large suite of pseudomorphs, a collection illustrating the physical characters of minerals, and a collection illustrating crystallography by natural crystals, showing both their normal and distorted forms. The minerals are accompanied by a large collection of models in wood showing the crystalline form of each. Arranged in wall cases are large specimens, showing the association of the minerals. There are also three separate student collections of average specimens, amounting in the aggregate to over 6,000 specimens.

ORES AND METALLURGICAL PRODUCTS.—A very complete collection of metallurgical products, illustrating the different stages of the type process in use in the extraction of each metal in this country and in Europe, is accessible to the students. The collection is constantly increasing. Most of the specimens have been analyzed and assayed.

MODELS OF FURNACES.—An extensive collection of models of furnaces has been imported. A very large number of working drawings of furnaces and machines used in the different processes is always accessible to the students.

APPLIED CHEMISTRY is illustrated by several thousand specimens of materials and products arranged in a cabinet of industrial chemistry for exhibition at the lectures and for inspection by the students.

THE GEOLOGICAL COLLECTION consists of over 100,000 specimens (to which additions are constantly made), forming the following groups:

1. A systematic series of the rocks and fossils characteristic of each geological epoch, numbering over 70,000 specimens.
2. A collection of ores, coals, oils, clays, building materials, and other useful minerals, illustrative of the course of lectures



on economic geology, and believed to give the fullest representation of our mineral resources of any collection yet made.

3. A collection of 5,000 specimens of rocks, and the minerals which form rocks, to illustrate the lectures on lithology.

4. A palæontological series, which includes collections of recent and fossil vertebrates, articulates, mollusks, radiates, and plants. In this series is to be found the largest collection of fossil plants in the country, including many remarkably large and fine specimens, and over 200 species of which representatives are not known to exist elsewhere. Also, the most extensive series of fossil fishes in America, including, among many new and remarkable forms, the only specimens known of the gigantic *Dinichthys*; a suite of Ward's casts of extinct saurians and mammals; fine skeletons of the great Irish elk, the cave bear, the New Zealand moas, *Ichthyosaurus*, *Teleosaurus*, etc.

5. Several hundred maps and diagrams illustrating the course of instruction; lanterns, microscopes, and over 2,000 slides to be used with them.

DRAWING MODELS.—There are, for the use of students, a large collection of flat models and of plaster casts; the Olivier models, forming all mathematical surfaces by silk threads, and admitting of a variety of transformations; also other models, illustrating general and special problems of descriptive geometry, shades and shadows, and stone-cutting; photographs of plaster casts and of parts of machines, for use in free-hand drawing; drawings of machines and parts of machines for studying and copying; also, landscapes in crayon and in water-color for instruction in sketching; models of mining machines and mining tools, stationary steam-engines, single and double cylinders, sections of steam-cylinders, water-wheels, turbines, shaking tables, stamps, crushers, blowing machines, pumps, etc.

SURVEYING INSTRUMENTS.—For the use of the students of the summer school of surveying there is a collection of instruments sufficient for over thirty surveying squads, comprising transits, levels, and plane tables by Heller & Brightly, Buff & Berger, Stackpole, and other makers; also compasses, dipping needles, hand levels, water levels, odometer, aneroid barometers, surveying cameras, tapes, chains, level rods, telemeters, sight poles, and tents and camp equipage.

CIVIL ENGINEERING is illustrated by a collection of models of beams, beam joints, roof and bridge trusses, masonry, doorways, arches, walls, culverts, bridges, and canal locks.

THE PROPERTIES OF MATERIALS are illustrated by numerous samples of rolled sections of iron, specimen frac-

tures and results of tests, and materials which have failed under strain and wear and tear in service. A particularly interesting collection is accumulating of iron and steel rails which have worn out, and illustrates their structural properties.

MECHANICAL ENGINEERING is illustrated by a series of sectional models of water-motors, ventilating and other fans, steam-engines, pumps, etc.; by a collection of full-size or working models of transmissive machinery and kinematic combinations; by actual specimens of the fixtures and apparatus used in connection with steam plants, including injectors, etc., which are so mounted as to be exhibited practically under steam; and by a series of the test apparatus, gauges, dynamometers, speed recorders, indicators, thermometers, etc., used by engineers. There is also a growing collection of the smaller sizes of machines now in the market, such as caloric and gas engines, erected to run a 5" x 6" condensing steam-engine, a Fairbanks' testing machine, and a working installation of the Westinghouse automatic train brake. A 75-ton Emery testing machine has also been secured. Students also are expected to make certain tests upon the steam-engines which run for power purposes in the college grounds, and which are parts of the engineering apparatus of the department when applied to this use.

There have been recently added to the department of engineering for the use of students in geodesy, two four-metre compound bars with Borda's scales, etc., for measuring base lines; one standard four-metre bar; one eight-inch theodolite with horizontal and vertical circles for measuring horizontal angles and double zenith distances.

MINING ENGINEERING is illustrated by models of blowing engines, ventilators, mine shafts, tunnels, galleries, methods of walling, methods of tubbing shafts, methods of measuring shafts, shaft house, hoisting engines, safety cages, man-engines, ladders, shaking tables, washers, stamps, crushers, mining machines, lamps and tools, artesian well-borer, blasting apparatus, etc.

Additions to the various collections are constantly made.

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## ASTRONOMICAL OBSERVATORY.

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The astronomical observatory contains a set of portable astronomical instruments: a forty-six-inch transit, by Troughton & Simms; a combined transit and zenith in-

strument for time and latitude determinations; an equatorially mounted refractor of five inches aperture, to which is attached a spectroscope with the dispersive power of twelve flint-glass prisms of fifty-five degrees, by Alvan Clark; also a diffraction spectroscope with grating, by L. M. Rutherfurd, Esq.

A set of comparison apparatus, with electrodes, Plucker's tubes, coils, etc., accompanies the spectroscope.

Instruction in practical astronomy is given in the observatory to students of the third and fourth classes in the course of civil engineering.

By the gift of Mr. Rutherfurd there have been added to the observatory equipment: (1) An equatorial refracting telescope of thirteen inches aperture, supplied with a correcting lens for photographic work. With this instrument belong two micrometers for position measurements. (2) A transit instrument of three inches aperture by Stackpole & Brother. (3) A Dent sidereal clock. (4) A micrometer for measuring photographic plates, and sundry other pieces of apparatus. The observatory has a fine mean-time clock by Howard & Co., also a chronograph by Fauth & Co., a personal equation machine, etc. The observatory and instruments are lighted by electricity.

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## FELLOWSHIPS.

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### I.—JOHN TYNDALL FELLOWSHIP FOR THE ENCOURAGEMENT OF RESEARCH IN PHYSICS.

In June, 1885, Professor John Tyndall, of London, presented to the college \$10,800 for the encouragement of scientific research.

The trustees accepted the gift, and adopted the following resolution:

*Resolved*, That with the view of carrying into effect the intent and purpose of the said John Tyndall in making this donation, the following regulations are hereby adopted:

1. A fellowship is hereby established in Columbia College entitled the "John Tyndall Fellowship for the Encouragement of Research in Physics," to be held by some suitable person, who shall be either a graduate or a student in some department of Columbia College, but not necessarily a candidate for a degree.



2. The holder of the fellowship shall be nominated by the president and the faculty of the School of Mines, and appointed by the board of trustees. Such appointment shall be for the term of one year only, but the fellow, for the time being, shall be eligible for appointment from year to year upon the recommendation of the president and the faculty of the School of Mines.

3. The fellow so appointed shall be entitled to receive during his term of office the net income of the capital sum constituting the endowment, to be paid him in four equal quarterly instalments at the usual times of paying college officers, and the trustees of Columbia College guarantee that such net income will amount to at least \$648 a year, being six per cent. upon \$10,800, the fund presented to the college by Professor Tyndall.

4. It shall be the duty of the fellow so appointed to devote himself faithfully to the investigation of some subject in physical science, at this college or at some other in this country or abroad, under the supervision and direction of some known physicist approved by the president and the faculty of the School of Mines.

5. It shall be the duty of the said fellow to make a report quarterly to the president, giving an account of the work in which he has been engaged during the three months preceding; which report shall be certified by the physicist superintending and directing him.

6. In case of failure faithfully to fulfil the obligations imposed upon him, the said fellow shall forfeit all privileges and emoluments conferred upon him by his appointment to the fellowship, and on report by the president of such delinquency, the board of trustees may at any time declare the said fellowship to be vacant.

7. The foregoing regulations may at any time be altered or modified in any particular not in conflict with the deed of gift.

## II.—FELLOWSHIPS IN ARCHITECTURE.

In the year 1890 there were established in the department of architecture three travelling fellowships, one of \$1,300 by the trustees, in recognition of the liberality of Mr. F. Augustus Schermerhorn to this department; and two of \$1,000 each by gift of Mr. Charles F. McKim of this city.

These prizes are open to all graduates of the department of architecture, less than thirty years of age, and are awarded on alternate years.



The first competition for the Columbia Fellowship in Architecture took place in the spring of 1890. The prize was awarded to Mr. Arthur Alexander Stoughton of the class of 1888.

The two McKim Fellowships were first competed for in the spring of 1891. The prizes were awarded to Mr. Adolfo Carlos Muñoz del Monte of the class of 1888, and to Mr. Alexander McMillan Welch of the class of 1890.

### III.—UNIVERSITY FELLOWSHIPS.

In 1891-92 there are twelve in number ; in 1892-93 there will be eighteen ; and in 1893-94, and thereafter, twenty-four.

Rules for the Award :

1. The application shall be made prior to March 1st, in writing, addressed to the President of Columbia College. Applications received later than March 1st may fail of consideration. The term of the fellowship is one year, dating from July 1st. Residence should begin October 1st.

2. The candidate must give evidence

- (a) of a liberal education, such as a diploma already granted, or about to be received, from a college or scientific school of good repute ;

- (b) of decided fitness for a special line of study, such as an example of some scientific or literary work already performed ;

- (c) of upright character, such as a testimonial from some instructor.

3. The value of each fellowship is five hundred dollars. Payments will be based on the time during which the fellow shall have been in residence. The holder of a fellowship is exempt from the charges for tuition.

4. Every holder of a fellowship will be expected to perform such duties as may be allotted to him in connection with his course of study, which course shall be such as to lead to the degree of doctor of philosophy. He will be expected to devote his time to the prosecution of special studies under the direction of the head of the department to which he belongs, and before the close of the academic year to give evidence of progress by the preparation of a thesis, the completion of a research, the delivery of a lecture, or by some other method. He must reside in New York or vicinity during the academic year.

5. No holder of a fellowship shall be permitted to pursue a professional or technical course of study during his term. With the written approval of the president, but not otherwise, he may give instruction or assistance in any department of the university.

6. No fellow shall be allowed to accept remunerative employment except by written permission of the president, and the acceptance of any such employment, without such permission, shall operate to vacate the fellowship.

7. A fellow may be reappointed at the end of the year for reasons of weight. No fellow may be reappointed for more than two terms of one year each.

8. As these fellowships are awarded as honors, those who are disposed, for the benefit of others or for any other reason, to waive the pecuniary emolument, may do so, and still have their names retained on the list of fellows.

## REGISTER OF STUDENTS.

### STUDENTS STUDYING UNDER THE FACULTY OF THE SCHOOL OF MINES.

#### I.—UNDERGRADUATE COURSES.

##### ABBREVIATIONS.

- (A.).....Course in Architecture.  
 (C.).....Course in Analytical and Applied Chemistry.  
 (G.).....Course in Geology.  
 (M.).....Course in Metallurgy.  
 (C.E.).....Course in Civil Engineering.  
 (M.E.).....Course in Mining Engineering.  
 (S.E.).....Course in Sanitary Engineering.

##### FOURTH CLASS.

| NAME.                               | RESIDENCE.                               | CITY ADDRESS.           |
|-------------------------------------|------------------------------------------|-------------------------|
| George Mendenhall Anderson (A.)     | East Walnut Hills,<br>Cincinnati, O..... | 104 West 45th St.       |
| Collins Pechin Bliss (A.)           | N. Y. C.....                             | 423 West 154th St.      |
| Francis Blossom (C.E.)              | 440 Henry St., Brooklyn, N. Y.           |                         |
| Werner Boecklin, Jr. (C.E.)         | Burlington, Iowa.                        | 228 West 38th St.       |
| Richard Charles Boyd (C.)           | N. Y. C.....                             | 44 West 88th St.        |
| Francis Xavier Brosnan, A.M. (C.E.) | N. Y. C..                                | 146 West 74th St.       |
| Edward Buxton Cristy (A.)           | Greenwich, Conn.                         |                         |
| William George Eberhardt (M.E.)     | N. Y. C....                              | 450 West 22d St.        |
| Edward Goodwin (M.E.)               | Governor's Island, N. Y.                 |                         |
| John Francis Hawley (C.E.)          | Stapleton, S. I.                         |                         |
| Norman Bernard Holter (M.E.)        | Helena, Montana.                         |                         |
| Henry Frederick Hornbostel (A.)     | 39 Second Pl., Bkln., N. Y.              | 64 East 49th St.        |
| Frederick Sterling Keeler (A.)      | N. Y. C.....                             | 106 East 38th St.       |
| Frank Wilmarth Kinsey (C.E.)        | 10 South St., Newark, N. J.              |                         |
| George Leary (C.E.)                 | N. Y. C.....                             | 43 East 25th St.        |
| Frank Armstrong Lilliendahl (M.E.)  | 82 Danforth Ave.,<br>Jersey City, N. J.  |                         |
| Archibald Rogers Livingston (C.E.)  | N. Y. C.                                 |                         |
|                                     |                                          | 20 North Washington Sq. |

| NAME.                                  | RESIDENCE.                    | CITY ADDRESS.      |
|----------------------------------------|-------------------------------|--------------------|
| John Thomas Mahl (C.E.).....           | N. Y. C.....                  | 345 West 123d St.  |
| Edmund Howd Miller (C.)..              | Mont Moor, N.Y.C.             | 118 West 111th St. |
| Mariano Luis Mora (C.E.).....          | N. Y. C.....                  | 435 West 22d St.   |
| Alfred Raymond, A.B. (A.)....          | 123 Henry St., Brooklyn,      | N. Y.              |
| Elmer Skinner (C.E.)....               | 227 Cumberland St., Brooklyn, | N. Y.              |
| William Allen Strout (A.)....          | 366 Carlton Ave., Brooklyn,   | N. Y.              |
| Franz Charles Thomas (A.).....         | N. Y. C.....                  | 108 East 17th St.  |
| George Oakley Totten, Jr. (A.)..       | 62 North 11th St., Roseville, | Newark, N. J.      |
| Gustav Robitscher Tuska, B.S. (C.E.).. | N. Y. C.                      | 223 East 18th St.  |
| Rolla Barnum Watson (M.)..             | 403 Sibley St., Cleveland,    | O.                 |
|                                        |                               | 64 East 49th St.   |
| William Wiener, A.B. (C.)..            | 368 Washington St., Newark,   | N. J.              |
| Fourth Class.....                      |                               | 28                 |

## THIRD CLASS.

|                                            |                             |                    |
|--------------------------------------------|-----------------------------|--------------------|
| Louis Adolph Ansbacher (C.)....            | N. Y. C.....                | 17 West 52d St.    |
| Randolph Bolles (A.)....                   | Englewood, N. J.            |                    |
| Samuel Bookman (C.).....                   | N. Y. C.....                | 9 East 62d St.     |
| Henry Burden, 2d, A.B. (C.)....            | N. Y. C.....                | 121 East 35th St.  |
| George Holberton Casamajor (C.E.)..        | 372 Greene Ave., Bkln.,     | N.Y.               |
| William Cowles Clarke (M.E.)...            | Cranford, N. J.             |                    |
| Henry Chauncey Cryder (A.)....             | N. Y. C.....                | 29 East 28th St.   |
| Charles Francis Dolan (C.E.)....           | N. Y. C.....                | 111 East 129th St. |
| Charles Doscher (C.)....                   | 142 Ross St., Brooklyn,     | N. Y.              |
| Edward Léonce Dufourcq (M.E.)..            | N. Y. C.                    | 846 Lexington Ave. |
| Edward Benjamin Durham (M.E.)..            | 160 South Tenth Ave.,       | Mt. Vernon, N. Y.  |
| Basil Hicks Dutcher (C.).....              | N. Y. C...                  | 525 Manhattan Ave. |
| Charles Sheffield Faulkner (C.E.)..        | N. Y. C.....                | 48 East 22d St.    |
| Clarence Norman Fenner (M.E.)..            | Paterson, N. J.             | 364 Broadway.      |
| Samuel Friedman, B.E. (C.E.)..             | Tuscaloosa, Ala.,           | 107 East 26th St.  |
| Halbert Powers Gillette (M.E.)..           | Fairhaven, Washington.      |                    |
|                                            |                             | 52 East 49th St.   |
| Abbott Dean Granger (C.E.)....             | 198 Hooper St., Brooklyn,   | N. Y.              |
| Arthur Hay (M.E.).....                     | Springfield, Ill.           | 52 East 49th St.   |
| Walter Augustus Herckenrath, A.M. (C.E.).. | N. Y. C.,                   |                    |
|                                            |                             | 121 West 56th St.  |
| Oswald Jackson, Jr. (C.E.).....            | N. Y. C.....                | 16 West 12th St.   |
| Goodhue Livingston (A.).....               | N. Y. C.....                | 271 Fifth Ave.     |
| Lindsay Bartholomew Longacre (M.E.)..      | Spuyten Duyvil, N. Y.       |                    |
| Parker Cairns McIlhiney (C.)....           | 619 Grand St., Jersey City, | N. J.              |
| James Buell McKinlay (M.E.)...             | N. Y. C.....                | 108 West 79th St.  |
| Herbert Mapes (A.).....                    | N. Y. C.....                | 60 West 40th St.   |
| Frederic Charles Albert Meisel (C.)..      | 44 Strong Pl., Brooklyn,    | N. Y.              |
| Eugene Merz, B.S. (M.E.).....              | Astoria, L. I.              | 55 Maiden Lane.    |
| Frederick Emery Pierce (C.E.)...           | N. Y. C.....                | 22 West 45th St.   |



| NAME.                               | RESIDENCE.                         | CITY ADDRESS.     |
|-------------------------------------|------------------------------------|-------------------|
| Charley Murray Rice (C.E.).....     | N. Y. C.....                       | 28 West 49th St.  |
| Heinrich Ries (G.).....             | N. Y. C.....                       | 211 West 53d St.  |
| Albert Rosenthal (C.E.)....         | Goldsboro, N. C....                | 158 East 79th St. |
| Seward Merrill Savage (C.E.)....    | 2260 Pacific St., Brooklyn, N. Y.  |                   |
| George Carroll Southard (C.E.)..    | 125 Willow St., Brooklyn, N. Y.    |                   |
| Gustave Alfred Hubert Sticht (C.).. | 754 Flushing Ave., Bkln., N. Y.    |                   |
| Seth Justin Temple (A.).....        | Winona, Minn....                   | 150 East 45th St. |
| James Towart (C.E.).....            | 219 Decatur Ave., Peekskill, N. Y. |                   |
| Dudley Arthur Van Ingen (C.)...     | 135 Henry St., Brooklyn, N. Y.     |                   |
| Lloyd Warren, A.B. (A.).....        | N. Y. C.....                       | 520 Fifth Ave.    |
| Harry Claude Werner (A.).....       | N. Y. C.....                       | 120 East 65th St. |
| Robert Davis White (C.E.).....      | N. Y. C.....                       | 39 East 74th St.  |
| Clifton Nichols Windecker (C.E.)..  | Wellington, O.                     |                   |
|                                     | 33 Sidney Pl., Brooklyn, N. Y.     |                   |
| August Paul Windolph (A.).....      | N. Y. C.....                       | 280 West 25th St. |
| Third Class.....                    |                                    | 42                |

## SECOND CLASS.

|                                           |                                              |                   |
|-------------------------------------------|----------------------------------------------|-------------------|
| Chester Holmes Aldrich (A.)....           | Providence, R. I..                           | 44 Irving Pl.     |
| William Clark Ayres (A.).....             | 18 Herkimer St., Brooklyn, N. Y.             |                   |
| William Behrman (C.E.).....               | 201 Ross St., Brooklyn, N. Y.                |                   |
| Nathan Bendin (C.E.).....                 | N. Y. C.....                                 | 404 East 71st St. |
| Charles Hill Bergen (C.E.)..              | Red Bank, N. J..                             | 110 West 49th St. |
| Edward Raymond Bossange (A.)..            | N. Y. C.....                                 | 132 West 44th St. |
| William Frederick Brooks (A.)...          | N. Y. C.....                                 | 335 West 55th St. |
| Abraham Caspe, B.S. (C.).....             | N. Y. C.....                                 | 362 Broome St.    |
| George Hallett Clark (C.E.).....          | N. Y. C.....                                 | 59 East 67th St.  |
| LeRoy Clark, Jr. (C.E.).....              | N. Y. C.....                                 | 350 West 30th St. |
| Allen Cunningham (C.E.).....              | N. Y. C.....                                 | 57 West 53d St.   |
| Charles Dräsel (M.E.)..                   | 168 Webster Ave., Jersey City Heights, N. J. |                   |
| Antonio Gonzalez (C.E.).....              | N. Y. C.....                                 | 53 West 33d St.   |
| Luther Elwood Gregory (C.E.)...           | 406 Passaic Ave, Kearny, N. J.               |                   |
| Albert Worthington Hankinson (C.E.)..     | N. Y. C.                                     | 114 West 45th St. |
| Charles Rufus Harte (C.E.)..              | New London, Conn.                            | 15 East 11th St.  |
| Harry Garner Haskell (M.E.)....           | Delancy, Pa....                              | 1 East 55th St.   |
| Theodore Augustus Havemeyer, Jr. (C.E.).. | N. Y. C.                                     | 244 Madison Ave.  |
| Edwin Francis Hicks (C.)..                | Peekskill, N. Y. C.                          | 123 West 45th St. |
| Robert Hoyt (C.E.).....                   | Katonah, N. Y.                               |                   |
| Frederic Sackett Hyde (C.)..              | 215 Schermerhorn St., Bkln., N. Y.           |                   |
| William Walter Jackson (A.).....          | N. Y. C.....                                 | 335 West 18th St. |
| Henry Elmo Keyes (C.).....                | N. Y. C.....                                 | 1 Park Ave.       |
| John Joseph Kletchka, A.B. (C.E.)..       | 791 Greene Ave., Bkln., N. Y.                |                   |
| Edgar Day Knap (C.).....                  | N. Y. C.....                                 | 256 West 73d St.  |
| George Henry Knight, Jr. (C.)..           | 808 Prospect Pl., Brooklyn, N. Y.            |                   |
| Edward Laurence Kurtz (M.E.)..            | New Castle, Pa.,                             | 41 West 61st St.  |
| Oliver Hazard Perry La Farge (C.E.)..     | Newport, R. I.                               | 9 West 30th St.   |
| Charles Griswold Lane A.B. (A.)..         | Sandusky, O.,                                | 155 East 38th St. |

| NAME.                                   | RESIDENCE.                            | CITY ADDRESS.                        |
|-----------------------------------------|---------------------------------------|--------------------------------------|
| Arthur Comings Langmuir (C.)...         | 296 St. James Pl., Bkln., N. Y.       |                                      |
| Robert Coleman LeRoy A.B. (A.)..        | N. Y. C....                           | 109 East 18th St.                    |
| Alfred Liebmann (C.E.).....             | N. Y. C.....                          | 28 East 72d St.                      |
| Frederick Reuben Lord (C.E.)...         | Stapleton, S. I.                      |                                      |
| Alexy Joseph Malukoff (C.E.)...         | N. Y. C.....                          | 154 East 80th St.                    |
| William Diller Matthew, A.B. (G.)..     | St. John, N. B., Canada.              |                                      |
|                                         |                                       | 106 West 45th St.                    |
| George Kemp Mears (C.E.)..              | 128 West Jersey St., Elizabeth, N. J. |                                      |
| Frederick Malling Pedersen, B.S. (A.).. | N. Y. C.                              | 327 West 34th St.                    |
| William Arthur Pomeroy (M.E.)..         | Oswego, Oregon.                       | 66 West 38th St.                     |
| Gabriel Posada, B.S. (C.)..             | Medellin, Republic of Colombia, S. A. |                                      |
|                                         |                                       | 339 West 58th St.                    |
| Howard Nott Potter, A.B. (A.)..         | New Rochelle, N. Y.                   |                                      |
| Arthur Dickson Prince (C.E.)....        | N. Y. C.....                          | 75 East 54th St.                     |
| Francis Adolph Provot (C.E.)..          | Orange Valley, N. J.                  | 64 White St.                         |
| Edward Lincoln Raymond, A.B. (M.E.)..   | Roxbury, Mass.                        |                                      |
|                                         |                                       | 123 East 54th St.                    |
| George Frederick Reckhart (C.E.)..      | N. Y. C....                           | 500 West 35th St.                    |
| Marcus Tullius Reynolds, A.B. (A.)..    | Albany, N. Y.                         | 34 West 51st St.                     |
| William Pollard Robertson (C.E.)...     | N. Y. C....                           | 145 West 58th St.                    |
| Cary Tilden Rodman (A.)....             | 169 Congress St., Brooklyn, N. Y.     |                                      |
| George Austin Schroter (M.)..           | Denver, Col.                          |                                      |
|                                         |                                       | 297 Vanderbilt Ave., Brooklyn, N. Y. |
| Henry Atterbury Smith, Jr. (A.)..       | N. Y. C....                           | 460 West 44th St.                    |
| Albert Joseph Sulina (A.).....          | N. Y. C.....                          | 3 James Slip.                        |
| William Noyes Taintor (C.E.)....        | N. Y. C.....                          | 230 West 59th St.                    |
| William Tuttle (A.).....                | 520 Summer Ave., Newark, N. J.        |                                      |
| Benno Heyman Vogel (C.E.)....           | N. Y. C.....                          | 56 East 80th St.                     |
| Charles Frederick Walker (C.E.)..       | N. Y. C....                           | 326 West 113th St.                   |
| Second Class.....                       |                                       | 54                                   |

## FIRST CLASS.

|                                        |                   |                                    |
|----------------------------------------|-------------------|------------------------------------|
| Joseph Bartlett Acken (A.)....         | Haworth, N. J.... | 2 West 14th St.                    |
| Ignacio Ernesto Agramonte (C.E.)..     | N. Y. C....       | 435 West 22d St.                   |
| Abraham Horace Albertson (A.)..        | Bangor, Pa.       |                                    |
|                                        |                   | 9 Crescent Ave., Plainfield, N. J. |
| Leon Hyneman Barnett (M.)....          | N. Y. C.....      | 102 West 86th St.                  |
| Lewis Benedict (C.E.).....             | N. Y. C.....      | 126 West 45th St.                  |
| Adolph Black (C.E.).....               | N. Y. C....       | 1434 Lexington Ave.                |
| Marston Taylor Bogert, A.B. (C.)..     | Flushing, L. I.   |                                    |
| Gorham Lincoln Boynton (A.)..          | Sewaren, N. J.    |                                    |
| Samuel Coffin Brown (M.E.)....         | N. Y. C.....      | 42 East 57th St.                   |
| William Howard Buckhout (A.)..         | N. Y. C.          |                                    |
|                                        |                   | 178th St. and Valentine Ave.       |
| José Rollin de la Torre Bueno (M.E.).. | Lima, Peru, S. A. |                                    |
|                                        |                   | 40 East 51st St.                   |

| NAME.                                | RESIDENCE.                        | CITY ADDRESS.                           |
|--------------------------------------|-----------------------------------|-----------------------------------------|
| Percy Morris Burrill (M.).....       | Bartow-on-Sound, N. Y.            |                                         |
| Martin Austin Carpenter (M.E.)..     | West New Brighton, S. I.          |                                         |
| Carlos Yglesias Castro (M.E.)....    | San Jose, Costa Rica.             |                                         |
|                                      |                                   | 337 West 58th St.                       |
| James Raymond Chisholm (M.E.).       | 1154 Pacific St., Brooklyn, N. Y. |                                         |
| Francis Albertson Cokefair (C.E.)..  | Plainfield, N. J.                 |                                         |
| William Simpson Covell (A.).....     | N. Y. C.....                      | 42 West 76th St.                        |
| Dexter Bailey Dawes (A.).....        | Englewood, N. J.                  |                                         |
| John Van Blarcom Demarest (C.E.)..   | Scranton, Pa.                     |                                         |
|                                      |                                   | 205 West 135th St.                      |
| Archibald Douglas (M.E.)..           | Tarrytown, N. Y..                 | 157 Madison Ave.                        |
| Frederick William Douglas (C.E.)..   | N. Y. C.....                      | 72½ Irving Pl.                          |
| Walter George Douglas (A.).....      | N. Y. C.....                      | 17 East 81st St.                        |
| Chester Burnell Duryea (C.).....     | Garden City, L. I.                |                                         |
| Eugene Nelson Ehrhart (A.).....      | N. Y. C....                       | 128 West 124th St.                      |
| Henry George Emery (A.).....         | Nyack, N. Y.                      |                                         |
| Charles Thomas Esher (C.E.)....      | 243 Montgomery St.,               |                                         |
|                                      |                                   | Jersey City, N. J.                      |
| William Kinnie Fellows (A.)..        | Winona, Minn...                   | 150 East 45th St.                       |
| Hamilton Easter Field (A.).....      | Great Neck, N. Y.                 |                                         |
| Edward Pell Folger (C.E.).....       | 80 Quincy St., Brooklyn, N. Y.    |                                         |
| Reginald Guy Foster (C.E.).....      | N. Y. C.....                      | 16 East 31st St.                        |
| Paul Fuentes (M.E.) .....            | 133 Hudson St., Hoboken, N. J.    |                                         |
| Frank Chandler Hamilton, A.B. (M.).. | Upper Alton, Ill.                 |                                         |
|                                      |                                   | 210 Columbia Heights, Brooklyn, N. Y.   |
| Richard Cochran Hanson (C.E.).       | 136 Lincoln Ave., Newark, N. J.   |                                         |
| Henry Beaumont Herts (A.).....       | N. Y. C.....                      | 45 West 53d St.                         |
| Charles Russell Hewlett (A.)..       | 68 Remsen St., Brooklyn, N. Y.    |                                         |
| Henry Northey Hooper, Jr. (A.)..     | 494 Third St., Brooklyn, N. Y.    |                                         |
| Edwyn Chase Hoyt (A.).....           | New Rochelle, N. Y.               |                                         |
| Henry St. John Hyde (C.).....        | N. Y. C.....                      | 210 East 18th St.                       |
| Robert Jacobs (C.E.).....            | N. Y. C.....                      | 124 East 85th St.                       |
| Jacob Antoine Janin, Jr. (A.)....    | Eiken Ave., Stapleton, S. I.      |                                         |
| Edmund Hurt Jewett (C.E.).....       | N. Y. C.....                      | 2 Chelsea Sq.                           |
| Meyer Joffe (C.E.).....              | N. Y. C.....                      | 141 Division St.                        |
| Elliott Johnston, Jr. (C.E.).....    | N. Y. C.                          |                                         |
|                                      |                                   | Cambridge Hotel, 33d St. and Fifth Ave. |
| Lawrence Johnston (A.).....          | N. Y. C.                          |                                         |
|                                      |                                   | Cambridge Hotel, 33d St. and Fifth Ave. |
| Edward Marwedel Jones (C.E.)..       | N. Y. C.....                      | 312 West 28th St.                       |
| Renshaw Mason Jones (A.).....        | N. Y. C.....                      | 10 East 58th St.                        |
| Julius Charles Kastner (A.).....     | N. Y. C.....                      | 154 Second Ave.                         |
| James Mason Knox (C.) .....          | N. Y. C....                       | 150 West 125th St.                      |
| Joseph Walter Labaree (C.).....      | N. Y. C.....                      | 143 West 73d St.                        |
| Teodoro Larrea, A.B., B.S. (C.E.).   | N. Y. C.....                      | 26 West 31st St.                        |
| Thomas Lonsdale Leeming, Jr. (C.)... | 216 Park Pl., Bkln., N. Y.        |                                         |
| Richard Leopold Leo (A.).....        | N. Y. C.....                      | 35 Broad St.                            |



| NAME.                             | RESIDENCE.                           | CITY ADDRESS.      |
|-----------------------------------|--------------------------------------|--------------------|
| Harry Alfred Levy (C.E.)          | N. Y. C.                             | 9 East 65th St.    |
| Samuel Liebmann (C.)              | N. Y. C.                             | 32 East 72d St.    |
| George Evarts Low (A.)            | 12 Downing St., Brooklyn,            | N. Y.              |
| Charles Anthony Lupprian (A.)     | N. Y. C.                             | 205 East 82d St.   |
| James Donald McCalmont (C.E.)     | Franklin, Pa.                        | 6 East 44th St.    |
| Dudley McGrath (A.)               | 226 Jefferson Ave., Brooklyn,        | N. Y.              |
| Henry Stewart McKee (M.E.)        | N. Y. C.                             | 66 West 38th St.   |
| George Clinton Mackenzie (A.)     | Elizabeth, N. J.                     |                    |
| Valentine Everit Macy (A.)        | Irvington-on-Hudson.                 |                    |
|                                   |                                      | 18 West 53d St.    |
| John Edmund Magovern (M.E.)       | N. Y. C.                             | 1700 Broadway.     |
| John Danforth Mairs (A.)          | 165 Carroll St., Brooklyn,           | N. Y.              |
| Harris Kennedy Masters (M.E.)     | 246 Clinton St., Brooklyn,           | N. Y.              |
| Juan Antonio Medina (M.E.)        | N. Y. C.                             | 238 West 43d St.   |
| Henry Parish Meikleham (M.E.)     | N. Y. C.                             | 829 Lexington Ave. |
| Edwin Henry Messiter (C.E.)       | 130 Madison Ave., Elizabeth,         | N. J.              |
| James Leslie Miller (A.)          | N. Y. C.                             | 11 Chambers St.    |
| John Crannell Minor, Jr. (C.)     | N. Y. C.                             | 10 East 41st St.   |
| Mason Price Mizener (C.E.)        | Erie, Pa.                            | 155 Madison Ave.   |
| Richard Augustine Monks (C.E.)    | N. Y. C.                             | 139 West 121st St. |
| Charles Harold Montanye (A.)      | N. Y. C.                             | 145 West 11th St.  |
| Thomas Maria Newton (A.)          | N. Y. C.                             | New York Hotel.    |
| Frederick Harris Nichols (M.E.)   | 40 Eighth Ave., Bklyn.,              | N. Y.              |
| William Henry Nichols, Jr. (M.E.) | 353 Clinton Ave., Bkln.,             | N. Y.              |
| William Henry Nobs (C.)           | 10 Chestnut St., Newark,             | N. J.              |
| Francis James Oakes, Jr. (C.)     | N. Y. C.                             | 108 Madison Ave.   |
| Edward Moore Parrott, Jr. (M.E.)  | Arden, N. Y.                         | 188 West 137th St. |
| Fred Hull Parsons (S.E.)          | South Norwalk,                       | Conn.              |
| Harold Ashton Parsons (C.E.)      | South Norwalk,                       | Conn.              |
| Rudolph Henry Peppmuller (A.)     | Stapleton, S. I.                     |                    |
| George Perrine (C.E.)             | N. Y. C.                             | 716 West End Ave.  |
| Elias Podryabinnick (C.)          | N. Y. C.                             | 314 Henry St.      |
| Richard Bayley Post (A.)          | 338 Park Ave., Hoboken,              | N. J.              |
| John Lloyd Prince (M.E.)          | Flatbush,                            | L. I.              |
| Horatio Roop Reed (M.E.)          | N. Y. C.                             | 43 Morton St.      |
| Edgar Griffith Roberts (C.)       | 157 Kent St., Brooklyn,              | N. Y.              |
| Drew King Robinson (C.E.)         | N. Y. C.                             | 123 West 76th St.  |
| Monroe David Rosenau (M.E.)       | Tuscaloosa, Ala.                     | 107 East 26th St.  |
| Richard Montgomery Schell (A.)    | N. Y. C.                             | 365 West 23d St.   |
| Charles Depew Searle (C.E.)       | N. Y. C.                             | 32 West 126th St.  |
| Edward Paul Serrell (C.E.)        | N. Y. C.                             | 39 Gramercy Park.  |
| Charles Eunson Shade (M.E.)       | N. Y. C.                             | 122 West 87th St.  |
| Gadsden Edwards Shand, B.S. (A.)  | Columbia, S. C.                      |                    |
|                                   |                                      | 227 East 49th St.  |
| Gerald Fitzgerald Sherman (C.E.)  | Milton, N. Y.                        | 116 East 19th St.  |
| Otto Siebelts (M.E.)              | 25 Beacon Ave., Jersey City Heights, | N. J.              |
| Wilson Fitch Smith (C.E.)         | N. Y. C.                             | 36 West 36th St.   |



| NAME.                                | RESIDENCE.                       | CITY ADDRESS.     |
|--------------------------------------|----------------------------------|-------------------|
| John Charles Sprague (C.E.).....     | N. Y. C.....                     | 257 West 74th St. |
| Joseph Lauferty Steinam (A.)....     | N. Y. C.....                     | 31 West 95th St.  |
| Edwin Taylor (M.E.)....              | 146 Hooper St., Brooklyn,        | N. Y.             |
| George Francis Tennille (C.)....     | N. Y. C.....                     | 116 West 48th St. |
| John Almy Tompkins, 2d (A.)..        | New Brighton,                    | S. I.             |
| Charles White Trippe (C.E.).....     | N. Y. C.....                     | 128 West 71st St. |
| Augustus Trowbridge (C.E.).....      | Astoria,                         | L. I.             |
| Walter Underhill (A.)..              | 54 Eighth Ave., Brooklyn,        | N. Y.             |
| Lewis Herbert Vail (C.E.).....       | Locust Valley,                   | N. Y.             |
| William Dunham Vanderbilt (M.E.)..   | Garden City,                     | L. I.             |
| Frederic Van Wormer (A.)..           | Albany, N. Y. C.                 | 111 West 49th St. |
| Jules Joseph Vatable (A.).....       | N. Y. C.....                     | 17 West 36th St.  |
| Vincente Benedict Villa, B.S. (C.).. | Medellin, U. S. of Colombia,     | S. A.             |
|                                      |                                  | 114 East 45th St. |
| Henry Vincent Walker (C.)..          | 40 Broome St., Brooklyn,         | N. Y.             |
| Henry Marion Ward (M.).....          | N. Y. C.....                     | 784 Fifth Ave.    |
| Franklin Backus Ware (A.).....       | N. Y. C....                      | 1128 Madison Ave. |
| William Remsen Webb (C.E.)....       | N. Y. C....                      | 15 Lexington Ave. |
| William Young Westervelt (M.)...     | 70 Passaic St., Hackensack,      | N. J.             |
| Charles Henry Whipple, Jr. (C.E.)..  | 403 Washington Ave.,             | Brooklyn, N. Y.   |
| Theodore Greely White (G.)....       | N. Y. C.....                     | 39 West 26th St.  |
| George Muirson Woolsey (C.E.)..      | Astoria, L. I., 8 Lexington Ave. |                   |
| First Class.....                     |                                  | 118               |

## II.—POST-GRADUATE COURSES.

### PURSUING THE COURSE OF ELECTRICAL ENGINEERING.

#### REGULAR.

#### SECOND CLASS.

|                                            |                          |                    |
|--------------------------------------------|--------------------------|--------------------|
| Gano Sillick Dunn, B.S.....                | N. Y. C.....             | 66 West 93d St.    |
| William Horatio Freedman, C.E..            | N. Y. C....              | 120 West 125th St. |
| Arthur Stanley Ives, C.E....               | 33 Sidney Pl., Brooklyn, | N. Y.              |
| Thatcher Taylor Payne Luquer, C.E.         | 618 Henry St., Bkln.,    | N. Y.              |
| Joseph Thompson Monell, C.E...N. Y. C..... |                          | 236 West 22d St.   |
| Robert Bowie Owens.....                    | Greenwich, Conn.         |                    |
| Second Class.....                          |                          | 6                  |

#### FIRST CLASS.

|                                    |                                |                   |
|------------------------------------|--------------------------------|-------------------|
| Archibald Anthon.....              | N. Y. C.....                   | 13 West 35th St.  |
| Dwight Dana Book, C.E..            | 159 Washington Park, Brooklyn, | N. Y.             |
| John Sheafe Douglas, C.E.....      | N. Y. C.....                   | 72½ Irving Pl.    |
| Charles Edwin Knox.....            | N. Y. C....                    | 227 East 123d St. |
| Huntington Walcott Merchant, A.B.. | N. Y. C...                     | 38 West 11th St.  |

| NAME.                                | RESIDENCE.                       | CITY ADDRESS.     |
|--------------------------------------|----------------------------------|-------------------|
| Charles Howard Parmly, B.S.....      | N. Y. C.....                     | 344 West 29th St. |
| William Willis Rees, A.B....         | New Hamburg, Dutchess Co., N. Y. |                   |
| George Whitfield Whittemore, A.B.116 | Milton St., Brooklyn, N. Y.      |                   |
| First Class.....                     |                                  | 8                 |

## PARTIAL.

|                                    |                                 |                   |
|------------------------------------|---------------------------------|-------------------|
| Isaac Frank Badeau.....            | Lake Mahopac, Putnam Co., N. Y. |                   |
| Edward Hotchkiss Everit.....       | New Haven, Conn.                |                   |
| Arthur Wheeler Francis, A.B....    | 143 Noble St., Brooklyn, N. Y.  |                   |
| Newton Harrison.....               | N. Y. C.....                    | 433 East 51st St. |
| Clarence Henry Leyton.....         | Montclair, N. J.                |                   |
| Sylvanus Albert Reed, E.M., Ph.D.. | N. Y. C.....                    | 51 East 53d St.   |
| Harry Frederick Salmons.....       | Glen Ridge, N. J.               |                   |
| Partial.....                       |                                 | 7                 |

## PURSUING SPECIAL COURSES.

## ABBREVIATIONS.

|                    |                     |
|--------------------|---------------------|
| (Arch.).....       | Architecture.       |
| (Assay.).....      | Assaying.           |
| (Chem.).....       | Chemistry.          |
| (Geol.).....       | Geology.            |
| (Mech. Draw.)..... | Mechanical Drawing. |
| (Met.).....        | Metallurgy.         |
| (Min.).....        | Mineralogy.         |

|                                                   |                               |
|---------------------------------------------------|-------------------------------|
| Samuel Milbank Cauldwell, C.E. (Arch.)..          | N. Y. C.16 West 54th St.      |
| Walter Douglas (Chem., Met., Min., Assay., Geol.) | Spuyten Duyvil, N. Y.         |
| James Haviland Merritt, Ph.B. (Arch.)             | 3 Monroe Pl., Brooklyn, N. Y. |
| Lanssat Richter Rogers, A.B. (Arch.)..            | N. Y. C.59 West 49th St.      |
| James Rich Steers, Ph.B. (Mech. Draw.)..          | N. Y. C.10 East 38th St.      |
| Special .....                                     | 5                             |

## STUDENTS STUDYING UNDER THE UNIVERSITY FACULTY OF MINES.

## PURSUING A COURSE OF STUDY FOR THE DEGREE OF MASTER OF ARTS.

| NAME.                              | RESIDENCE.    | CITY ADDRESS.      |
|------------------------------------|---------------|--------------------|
| John Storm Appleby, Ph.B.....      | N. Y. C.....  | 216 West 59th St.  |
| Edwin Solis Brickner, B.S.....     | N. Y. C....   | 812 Lexington Ave. |
| Charles Riborg Mann, A.B.....      | Orange, N. J. |                    |
| Harry Wheeler Powell, B.S.....     | N. Y. C.....  | 116 W. 129th St.   |
| For Degree of Master of Arts.....4 |               |                    |

## PURSUING A COURSE OF STUDY FOR THE DEGREE OF DOCTOR OF PHILOSOPHY.

|                                         |                                   |
|-----------------------------------------|-----------------------------------|
| Edwin Mortimer Blake, E.M....           | 230 Washington Ave., Bkln., N. Y. |
| Harold Griffing, A.B.....               | N. Y. C....605 Columbus Ave.      |
| Edward Gudeman, Ph.B.....               | N. Y. C.....40 East 69th St.      |
| Lionel Remond Lenox, Ph.B....           | South Bethlehem, Pa.              |
| James Maclay, C.E.....                  | 312 Summer Ave., Newark, N. J.    |
| For Degree of Doctor of Philosophy....5 |                                   |

## SENIORS OF THE SCHOOL OF ARTS PURSUING ELECTIVE STUDIES.

|                                        |                                   |
|----------------------------------------|-----------------------------------|
| Charles Bartow.....                    | Astoria, N. Y.                    |
| Charles Butler, 2d.....                | N. Y. C.....130 East 24th St.     |
| Oliver Samuel Campbell.....            | 18 Remsen St., Brooklyn, N. Y.    |
| Frederick Woodhull Chesebrough.        | N. Y. C.....17 East 45th St.      |
| Richard Collins.....                   | Purchase, N. Y.                   |
| Frank Nélaton Dodd.....                | 205 Carlton Ave., Brooklyn, N. Y. |
| Albert Rolaz Gallatin.....             | N. Y. C.....7 West 38th St.       |
| Arthur C. Gwynne.....                  | Rye, N. Y.                        |
| Edward Hymes.....                      | 43 Clinton St., Newark, N. J.     |
| Asa Stewart Iglehart.....              | 246 Mulberry St., Newark, N. J.   |
| Philip Edwards Johnson.....            | New Brighton, S. I.               |
| Joseph Chaim Josephson.....            | Rochester, N. Y.                  |
| George Gillis Leonard.....             | N. Y. C.....107 West 73d St.      |
| George Washington Metcalfe....         | N. Y. C.....354 West 51st St.     |
| Alfred Bernard Moldenke.....           | N. Y. C.....124 East 46th St.     |
| Adam Gordon Norrie.....                | N. Y. C.....377 Fifth Ave.        |
| Richard Suydam Palmer....              | N. Y. C.....24 East 39th St.      |
| Dwight Wilcox Taylor.....              | N. Y. C.....500 Madison Ave.      |
| Herbert Edward Tuttle.....             | N. Y. C.....127 West 63d St.      |
| Oswald Werner Uhl.....                 | N. Y. C.....113 East 60th St.     |
| Franklin Mott Warner.....              | N. Y. C....250 Lexington Ave.     |
| Henry Wolcott Warner.....              | N. Y. C....250 Lexington Ave.     |
| John Barrea Zabriskie.....             | Flatbush, L. I.                   |
| Seniors from the School of Arts.....23 |                                   |

## SUMMARY.

## Undergraduate Courses :

|                   |       |     |
|-------------------|-------|-----|
| Fourth Class..... | 28    |     |
| Third Class.....  | 42    |     |
| Second Class..... | 54    |     |
| First Class.....  | 118   |     |
|                   | <hr/> | 242 |

## Post-Graduate Courses :

## Electrical Engineering—

|                   |       |    |
|-------------------|-------|----|
| Second Class..... | 6     |    |
| First Class.....  | 8     |    |
| Partial .....     | 7     |    |
|                   | <hr/> | 21 |
| Special. ....     | 5     |    |
|                   | <hr/> | 26 |

## University Courses :

|                                         |       |   |
|-----------------------------------------|-------|---|
| For Degree of Master of Arts.....       | 4     |   |
| For Degree of Doctor of Philosophy..... | 5     |   |
|                                         | <hr/> | 9 |

|                                      |  |    |
|--------------------------------------|--|----|
| Seniors from the School of Arts..... |  | 23 |
|--------------------------------------|--|----|

|                  |  |           |
|------------------|--|-----------|
| Grand Total..... |  | <hr/> 300 |
|------------------|--|-----------|



## GRADUATES IN 1890.

## ENGINEERS OF MINES.

|                         |                           |
|-------------------------|---------------------------|
| Alexander Leslie Black, | Albert Lincoln Levy,      |
| Edwin Mortimer Blake,   | Manuel Rafael Montenegro, |
| William Monroe Davis,   | Howard Farrington Welsh.  |

## CIVIL ENGINEERS.

|                             |                               |
|-----------------------------|-------------------------------|
| George Alexander Beckwith,  | Alger Crocheron Gildersleeve, |
| Romeo Thompson Betts,       | Charles Edward Gudewill,      |
| Dwight Dana Book,           | Charles Henry Hart,           |
| Joseph Carson,              | John Sherman Hoyt,            |
| Diego Lombillo Clark, A.B., | Elisha Denison Hurlbut, Jr.,  |
| Hewlett Ralston Connell,    | Louis Ferdinand Massa,        |
| Thomas Cornell Coykendall,  | Thomas Mann Randolph Meikle-  |
| Andrew Ernest Foyé,         | ham,                          |
| Albert Cassimir Fowler,     | José Portuondo.               |

## METALLURGICAL ENGINEERS.

|                            |                          |
|----------------------------|--------------------------|
| Fred. Irvan Cairns, A. B., | Thomas John Jones,       |
| George Jewett Hicks,       | William Henry McKleroy,  |
| Frank Cyrus Hooper,        | Thomas Matthew St. John. |

## BACHELORS OF PHILOSOPHY.

## IN THE COURSE OF ANALYTICAL AND APPLIED CHEMISTRY.

|                         |                           |
|-------------------------|---------------------------|
| Joseph Albert Deghuée,  | Bertrand Chase Hinman,    |
| George Albert Ferguson, | Herschel Clifford Parker, |
|                         | James Rich Steers.        |

## IN THE COURSE OF ARCHITECTURE.

|                               |                               |
|-------------------------------|-------------------------------|
| Samuel Wakeman Andrews, Jr.,  | Robert David Kohn,            |
| Hermann Behlen,               | Edward Gervaise Lichtenstein, |
| Will A. Buckland,             | William Shepherd Lowndes,     |
| William Robert Clayton, B.S., | Horace Borchsenius Mann,      |
| Frederick Gray Colton,        | Harry Colden Pelton,          |
| Lloyd Wiegand Fisher,         | William Stone Post,           |
| James Munroe Hewlett,         | William Lincoln Thorne,       |
| Meyer Jarmulowsky,            | Charles Peck Warren,          |
|                               | Alexander McMillan Welch,     |

## DOCTORS OF PHILOSOPHY.

|                             |                                  |
|-----------------------------|----------------------------------|
| Bashford Dean, A.M.,        | Frederick James Hamilton Mer-    |
| Frank Despard Dodge, Ph.B., | rill, Ph.B.,                     |
| Herman Hollerith, E.M.,     | Alfred Joseph Moses, E.M.,       |
|                             | Charles Henry Smythe, Jr., Ph.B. |

## CALENDAR.

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- 1891—June 5.—Examinations for admission begin, Friday.  
 Sept. 28.—Examinations for admission begin, Monday.  
 Oct. 5.—First term, 138th year, begins Monday.  
 Nov. 3.—Election day, holiday, Tuesday.  
 Nov. .—Thanksgiving day, holiday.  
 Dec. 21.—Christmas holidays begin, Monday.
- 1892—Jan. 4.—Lectures resumed, Monday.  
 Jan. 25.—Examinations begin, Monday.  
 Feb. 3.—First term ends, Wednesday.  
 Feb. 4.—Second term begins, Thursday.  
 Mar. 2.—Ash-Wednesday, holiday.  
 Feb. 22.—Washington's birthday, holiday, Monday.  
 April 15.—Good-Friday, holiday.  
 May 16.—Annual examinations begin, Monday.  
 May 30.—Decoration day, holiday, Monday.  
 June 3.—Examinations for admission begin, Friday.  
 June 8.—Commencement, Wednesday.









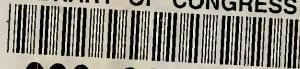








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